LIBRARY OF CONGRESS,
MAR 26 1894
COPYRIGHT DEPOSIT.

THE AMERICAN

GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME LX.—No. 13. Whole No. 981. | NEW YORK, MONDAY, MARCH 26, 1894. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. R. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND CLASS MATTER.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICE—
Pacific Coast Gas Association, Second Annual Meeting 437
EDITORIALS—
Tenth Annual Meeting of the Ohio Association—Special Editorial Correspondence 437
*Notes on Gasholders in Metal Tanks, by M. Godinet 438
*The Loss of Light from the Use of Globes with Arc Lamps, by Mr. G. D. Shepardson 441
*Forbes Form of Apparatus for the Estimation of Carbonic Acid ... 442
Concerning Uniformity of Electrical Apparatus, by Dr. Louis Bell 442
The Consumption of Coal Gas for the Generation of Light, by Prof. V. B. Lewes, F.I.C 443
ITEMS OF INTEREST FROM VARIOUS LOCALITIES 447
Something from Current Annual Report of Board of Gas and Electric Light Commissioners—Reorganization of the Madison (Ind.) Company—Cheaper Gas for Geneva, N.Y.—An Awful Bill—Changes in Clerical Staff, Philadelphia Gas Bureau—Commissioners Order a Reduction in the Charlestown, Mass., Gas Rate—Death of Horace Nichols—A Thrifty Board of Valuers—Contract for the Berlin Bridge Company—To Close Down the South Boston Works—The Brookline Company May Increase its Capital Stock—Pintsch Plant at Indianapolis—Public Lighting, Wilkes-Barre, Pa.—The Cicero Company's Newest Pamphlet—Mr. Taylor Declines to Stand for Congress—Minute to the Memory of Mr. Torrey, Honesdale, Pa.—Death of Mr. R.W. Hardy—And Many Other Items.
Two "Hints" from President Smythe's Address 449
The Market for Gas Securities 450

[OFFICIAL NOTICE.]

Pacific Coast Gas Association, Second Annual Meeting.

OFFICE OF THE SECRETARY, OAKLAND, CAL., March 5, 1894.

Upon the suggestion of Mr. Jos. B. Crockett, our President, and with the concurrence of the Directory, it has been decided to hold the next meeting of this Association at Sacramento, on Tuesday and Wednesday, the 15th and 16th of May, 1894.

This has been done to afford an opportunity to members to combine the business of our annual conclave with the pleasure of a visit to the Midwinter Fair, as the time appointed by the by-laws would be after the Fair had closed, and many if not all of the members who live at a distance from San Francisco will thereby be saved the necessity of making two trips to the bay.

Our first meeting was a complete success—the second will not be behind it in interest. Already papers are promised upon topics of interest to gas men, among them being "Practical Analysis of Gas," illustrated with complete apparatus, "Proper Books of Record for Gas Companies," and "Prepayment Meters."

Each member's presence is necessary to the preservation of an organization whose ultimate object is the bringing together in unity of thought and action the gas fraternity. Come prepared to ask questions, to give and receive information. The good accomplished by the last meeting has been felt throughout the year in better results of manufacture and distribution. The pertinent question personally asked and answered is productive of more results than volumes of print.

In order that arrangements may be made for your care and comfort while at Sacramento, please advise me on receipt of this if you intend to be present. You will be later advised concerning headquarters, place of meeting, hotel accommodations, etc.

We want at this meeting a perfect circulation of members, and no dead ends. Yours very truly, JOHN A. BRITTON, Secretary.

[Special Editorial Correspondence.]

TENTH ANNUAL MEETING OF THE OHIO ASSOCIATION.

COLUMBUS, OHIO, March 21, 1894.

Dear JOURNAL: The first day's sessions of the Ohio's Tenth Annual have been finished, and they were well worth the time and trouble involved in making a long journey to be in attendance thereon; and it is with much satisfaction I write that the Association was favored by an excellent attendance, which goes to show that the Buckeye gas man is a firm believer in the good which results from organization and active participation therein. The wonderful March season that you have so far enjoyed in the East seems to have been the rule the country over, for the opening session was graced by the fairest of spring weather—a warm, pleasant morning, beaming with the beauties of spring, greeting the delegates on their way to the meeting room, which, as you know, was the cosey hall of the Columbus gas works. The notables present included Messrs. Greenough, Somerville, Chollar, Dell (the only "John"), Higgins and his lieutenant, Persons, McIlhenny, Donald McDonald (of Albany), "Dan" Russell, Gribbel, Hayward, Shelton, Stout, Addicks, and many others. In all, I should say four score answered to their names, which is proof that my earlier assertion of an excellent attendance was well within the facts. Under President Butterworth's careful guidance the Association lost no time in getting down to business, which latter was introduced by some reports of more than ordinary interest. The reports of the standing committees (executive and finance), together with the annual statements of the Secretary and Treasurer, showed the sound footing and stability of the Association, and these were followed by a comprehensive statement from the special Committee which was appointed a year ago to consider and report upon the best means of securing the best possible return to the Companies of the State for the tar produced by them. Some weeks ago the JOURNAL published an advance statement from the Committee, which carried on its face the fact that Ohio at least was not only anxious but ready to go into the thing practically; and we may assume that this anxiety and readiness are about to bring forth fruit, for the Committee has secured the pledges of six Ohio Companies to assist in this movement on joint account. It is estimated—and the estimate is certainly within 12½ per cent. either way of actual expenditure—that $8,000 will erect and equip the necessary plant, and thus emancipate the Buckeye gas man from the bondage of the tar ring. One noteworthy item brought out by the researches of the Committee is that one of the most important consumers of tar products is the electric lighting industry, whose carbon pencils annually absorb thousands of tons of tar products in their preparation. The Committee was continued, and we have no doubt that within the year the actual working up of the tar products will have been begun by the Ohio Companies. President Butterworth's inaugural message was a practical paper, which discussed in straightforward way many points of interest to the fraternity. In discussing the proposed federation of

the Associations, while leaning to the idea in general, in that he recommended the appointment by the Ohio Association of a Committee to take part in the general conference of the Associations called for the meeting of the Western at Cleveland in May, it is nevertheless prominent that he holds strongly for maintaining the individuality of the Ohio Association; for how can we hold differently from hearing him remark "that our Association is good for many more years of useful life is probable." Indeed, it seems to me that this problem of federation is still in the very distant future, and as I behold it, it is extremely far of realization, save in what may be termed a most desultory way. Talking with the members here upon the subject—not in meeting, mind you, but in the time outside of the convention, when the speaker is more prone to give unrestrained vent to his views—I have heard it said more than a half score of times, and by an equal number of speakers, that the chief beneficiary of anything or any measure looking to federation would be the American Association; and while all are willing to yield to that body loyal support, they nevertheless are apt to draw the line at support which even savored of sinking the individuality of the Association, which because of home ties—so-to-speak—or of personal favor, holds the first and warm est place in their allegiance. The President also gave an exceptionally clever statistical explanation of why unfavorable weather (from the gas maker's standpoint) in the fall and winter months aided the "hard times" in cutting down so far the gas output for the year 1893-4. Indeed, what with "bright weather and hard times" the West and the East have common cause for mutual consolation. He also gives the devil—kerosene—its due for the part played by it in curtailing the gas man's domain, but was also ready with a satisfactory means of casting out the oil lamps of the "piano" and "stand" and other varieties which the housekeepers of all degrees have been so enamored of late years. Not only did he tell about gas lamp substitutes for their oily predecessors, but he had them in full view of his audience, who marvelled greatly at the splendor of the exhibition. There were lamps of the piano and banquet sorts, drop lights for reading, and so on, lamps for odd illuminating effects—any and all of which might be shaded, draped or bedizened in any bizarre or orthodox way to suit the particular fancy of my ladye faire. They are portable, handsome and not costly; and they do not give off any offensive odor—as, for instance, the best Rochester in the world will develop if the oil well has been neglected. I understand these "gas lamps" are almost ready to be put on the market, and I am sure they will "take." The President also devoted goodly consideration to the probable future of gas in general, with respect of prices and in other ways, and he sturdily held to the view that "gas can both now and hereafter easily compete with it [electricity] in cost for lighting." The address was practical, sensible and convincing. The papers read were interesting and led to goodly discussion; Mr. Anson's contribution on "Testing Meters" being particularly attractive to the convention, as was Mr. Cline's paper on "Welsbach Burners with Artificial Gas." The attendance at the Hall, in fact, was notable for the close attention paid to the business in hand, which was always well controlled by the Chairman. The only thing approximating to entertainment was a really good supper at the Neil House, which was participated in by a large number of the members and guests.—Y.

Thursday, March 22.

The weather conditions to day are not as pleasant as those of yesterday, a rainy spell having broken the charm, but the general interest in the proceedings was fully maintained. The paper of the day, if one may judge from the lively and lengthy discussion that followed its reading, was that by Dr. Howard Jones on the "Joint Business of Gas and Electric Light." The Doctor's contribution was in the shape of a compilation of the experiences of his Company at Circleville, O., in the joint venture; and although he favored the plan, his indorsement of it, however, cannot be said to have been of the most unqualified. In fact, if I quote you its closing paragraph, I think I shall have revealed the Doctor's position on the moot point. He says: "While our earnings are not at present such as would satisfy some investors, yet we feel assured of our position with the citizens, and hope always to deserve the same kind feeling which most of them now accord us." The discussion, as usual, disclosed a wide range of opinion, but I think I am close to truth in saying that the majority were opposed to a "combination." The technical proceedings were full of interest, and I am safe in saying that the "tin wedding" of the Ohio was an unqualified success. The names of 20 members were added to the rolls, and the officers chosen were:

President—J. W. R. Cline, Springfield.
Vice-President—W. W. Cantine, Alliance.
Secretary and Treasurer—A. P. Lathrop, Columbus.
Executive Committee—T. C. Jones, E. T. McCormack and W.C. Boyle.

The place of meeting for next year is the home of the President-elect—Springfield. Y.

[Translated for the JOURNAL by Mr. Herman Poole.]

Notes on Gasholders in Metal Tanks.

[A paper read by Mr. Godinet, before the French Association of Gas Managers.]

During the past years a great number of gasholders with metal tanks have been built. We cannot state at first glance that a metal tank is preferable to a masonry one, or inversely, for it is necessary in each case to study the details of the question before adopting either of the two solutions.

When we select for the future gasholder a larger site than is necessary; when the ground is good for excavation, for the foundations as well as to make a good embankment around the pit; when we can procure cheaply the stone, the cement, and when we have time sufficient to allow the cement to harden and take hold well before putting the water in the pit, the construction in masonry appears to us to be preferable. But when, on the contrary, we can secure only a small site; when we must consider the room to be occupied by the thickness of the walls of a masonry pit; when the subsoil of the ground is in water and cannot be excavated without costly methods, these lead us to put the tank above ground. When we have to build on a moving ground, as in the case of Firminy (see the *Compte Rendu* in 1882, communication of Mr. Largeron), when it is far from quarries and near rolling-mills—when, in short, we have only a limited time before us to construct and put into service, and when we must work at the tank in winter under a rigorous climate where frost prevents the use of masonry, metal, spite of its inconveniences, may be reasonably preferred to masonry.

Metal tanks always have the following objections: Being generally put up in the air on the ground level, the gasholder is more elevated than it would be in a sunken pit, and the wind, especially with gasholders with several lifts, has more action on the bell; it is necessary, therefore, to brace more strongly.

The water which fills a metal tank, on account of the conductibility of the tank, rapidly follows the change of temperature of the external air, and in severe winters it is expensive to thaw out the water, which might on freezing produce the most grave accidents. I cite the example of a works where it was necessary to use about a ton of coal a day of 24 hours during the cold portion of one month, while the mean external temperature was from 6° to 10° F., in order to maintain the temperature at 37° F., there being some 175,000 cubic feet of water in the tank. The surface of the wall of the tank in contact with the air was about 150 square feet, per 3,500 cubic feet of contained water.

In short, at least to take the costly arrangement of a spherical bottom, or that of the one on posts described in 1882 by Mr. Largeron, the frame of the metal reservoir is difficult of access and repair, and the duration of a metal one cannot be equal to that of one of good masonry.

In the commencement of the construction of metal tanks, we see figured those in cast iron and hooped, which Schilling described in his work, and which has been set up at Hamburg on piles over a bad bottom. They were sunken, and the embankment which surrounded the walls had allowed a lessening of the thickness.

Next were constructed cast wells, exterior to the soil and formed of panels with flanges bolted together. This system of construction, with the exception of particular cases, is to-day abandoned, and it is because of several grave accidents having taken place in cast iron tanks which have burst and inundated the surrounding country. Such an accident happened to the works at Bone, Algiers, in 1889. Another, not less grave, happened at Versailles. We may conclude from it that cast iron has not sufficient elasticity to form cylindrical reservoirs of which the section is not always mathematically circular from faults in construction, and which often tend to become considerable under the pressure of the water. Besides this effect of tension, there are produced effects of flexion under which cast iron tends to break.

Metal tanks are to-day constructed almost exclusively of iron plates. We should as much as possible employ a metal which is even in ordinary qualities resisting, homogenous, flexible, and which has a limit of elasticity amply sufficient to support without danger the ill usage of service.

Steel may be likewise employed, but with much more precaution, as it has occasioned disappointments. It is necessary that all steel employed in the tanks should be homogeneous; but in a lot composed of a large number of sheets it is rare that we do not find, in spite of all the most minute care and the most active control, some which cooled too quickly or, irregular in lamination, will show characters of partial faults; these plates may be torn suddenly, or burst in some manner, without any apparent cause sufficient to produce such a rupture.

To prevent the great cost which would attend the boring of the holes for the rivets by a bit, we are accustomed, at least in thicknesses up to an inch, to punch this out. It is to be remarked that iron of good quality stands this treatment better than steel, when it is not very soft and annealed. In short, with this last metal, there are often produced cracks between the rivet holes and the edge of the sheet, cracks which are rarely met with in iron sheets of the same thickness. We may add that the good sheets of steel, which are very soft, cost a very high price, which fact prevents their employment.

In spite of the large number of metal tanks put into service in the last few years, we have not yet that I know of witnessed the construction of any very large ones—I mean those holding 800,000 to 1,000,000 cubic feet of water or more. We are stopped by the practical difficulties which we can surmount only with a great and unallowable expense.

The tank should resist the pressure of the water which tends to open it according to the laws of the cylinder, and for the large reservoirs the forces at work are considerable, necessitating for the lower portions of the vertical walls the employment of very thick sheets, difficult to handle, bend, put in place, and in which the rivet holes can only be made by the drill.

For the largest metal tanks which to my knowledge have been constructed, and which contain about 700,000 cubic feet of water, the combined difficulties were so great that they abandoned the construction with sheets alone and employed a mixed one of cast and sheet iron. The tanks have been built by means of thick panels of cast iron, with flanges and ribs bolted together and reinforced by thick bands of iron, kept in place by the bolts of the horizontal joints.

This construction, which has been adopted in Holland, is delicate, and does not certainly provide against cataclysms which may result from the breaking of the panels of cast iron.

The thickness of the vertical wall of a metal tank is given by the formula—

$$E = \frac{1}{2} D \frac{P}{T}$$

in which—

E = the thickness, in inches.

D = the diameter of the tank, in inches.

P = the effective pressure in pounds per square inch.

T = the tension per square inch to which we may strain the metal in full sheet. The thickness varies as the diameter of the tank and as the pressure at a given point.

So that the thickness of the bottom of the vertical wall of a tank holding 1,200,000 cubic feet of water, having 184 feet diameter and 47 feet high (these dimensions are those of the tanks of the gasholders at the Landy works, see *Compte Rendu de la Societe Technique*, for 1889), and working the metal at a tension of 15,460 pounds per square inch, will be—

$$E = \frac{1}{2} 2{,}208 \frac{22.436}{11{,}400} = 2\ 16 \text{ inches.}$$

Sheets of 2 inches thickness are veritable plates, and are easily broken, considering all the trouble which accompanies their use.

On the other hand, the riveting becomes very difficult. Referring to the example cited above, besides the necessity of making all the rivet holes by the drill, if we wish for the rivets a strain of not more than 17,000 pounds per square inch (and this tension is high), it is necessary for the bottom plate, which supports a force of over 27,000 pounds per foot in height, to have for these rivets a section of $\frac{280.000}{170,000} = 16.5$ inches, and the plate between the rivets should have the same section.

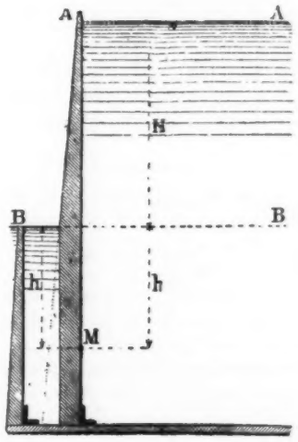
These conditions can be fulfilled only by use of multiple riveting. We will put, for example, 15 rivets of 1.2 inch diameter per foot of vertical seam, dividing them into three or four rows, or even 22 rivets of 1 inch diameter divided into four rows.

Spite of this multiple riveting, heavy to excess, the solution will be inadmissible. We see at once that the cost of such a construction prevents its being employed.

Practically, it is not necessary to employ plates of more than 1 inch thickness. We cannot punch holes in plates above that thickness, and it is beyond this thickness, for which the double riveting suffices, that all the difficulties mentioned above begin.

The new arrangement we believe, which we have the honor to present to the Association, and which permits construction of tanks of large dimensions with plates of moderate thickness, consists in the employment of two or more concentric pits simultaneously, fastened together by angle iron and rivets on a single radius. The distance which separates two adjoining cylinders is as small as possible, but should nevertheless be sufficiently great to allow setting up and easy riveting. The central one has the dimensions required by the demands of the case, and the others are successively less and less in height in proportion as they are away from the center. The central one and the annular reservoirs formed by the concentric walls are all filled with water or liquids having the same density.

The accompanying figure shows a vertical section of such a pit with multiple walls.



A A is the water level of the central one, and *B B* is the water level of the next cylinder. From *A* to *B* the thickness of the central cylinder should be calculated by the formula given above as in the case of a gasholder with a single wall. Below *B*, to the bottom of the reservoir, the effective pressure which tends to open the central cylinder remains constant and the thickness of the wall should remain constant.

In short, for any point *M*, situated at a height *h*, below the level *B*, and at a distance $H + h$ below the level *A*, the effective pressure is always constant, for we have—

$$P = \frac{H + h - h}{\text{constant}} = \frac{H}{\text{constant}} = \text{constant.}$$

The pressure of the water from the exterior cylinder balances the pressure of the same height of water in the interior cylinder.

We see from this that, in placing the level of the exterior water at a convenient height, the walls of the central cylinder may be constructed with plates of moderate thickness.

The exterior cylinder will be calculated in its turn, and if its thickness be above the limit we do not wish to pass, we may remedy it by employing a third cylinder, and so on.

This disposition demands approximately the same weight of plates as the single tank system. Theoretically, if the two cylinders were near enough to touch, the weight of the plates would be the same in both cases.

Practically, the arrangement of multiple cylinders demands, on one hand, a larger radius, and on the other, the protecting cylinder having a greater diameter than the central one, its walls should have a thickness and development somewhat greater. This causes an increase of weight.

This is compensated by a greater economy than appears at first view, which results from the use of double riveting, where, in the case of a single cylinder, three or four rows of rivets would have been needed. The laps are smaller, and as we avoid laps of very thick plates the weight saved is important.

So that, in the case of the gasholder of 184 feet diameter and 47 feet height, the use of two cylinders separated 2 feet apart, we should have the following changes in weight:

1. 10,764 sq. feet of frame, at 16.36 lbs. per sq. ft., say.....17,600 lbs.
2. Increase of $\frac{1}{32}$th inch in thickness of the exterior cylinder, 23.6 feet × 187.6 feet × π × 1.644 = ...23,000 lbs.
3. Increase from enlargement of the exterior cylinder, mean thickness $\frac{1}{2}$ inch, 23.6 feet × 3.94 × π × 22.55 = ... 6,600 lbs.
4. Angle iron joining the walls to the frame, 586.4 feet at 13.4 lbs = ... 7,900 lbs.

Total weight added.....55,100 lbs.

Inversely this arrangement allows the use of double riveting in all joints. If, in the case of the single cylinder, we had put on the lower half of it triple or quadruple rivetings, the laps on the plates of a mean thickness of $1\frac{1}{2}$ inches would be about $4\frac{1}{2}$ inches longer. If the cylinder,

whose circumference is 508 feet, had been built of plates of 8 feet length, it would have needed 73 per section.

The weight of plates economized in the laps is 73 × 23.6 × .39 × 61.5 = 41,400 lbs.

We see then that the system of double cylinder would employ some 13,000 lbs. more of iron.

This weight is of little importance in a work which would weigh for the cylinder alone some 1,300,000 lbs. It is only 1 per cent.

The economy of this system rests entirely in the employment of sheets of practical moderate thickness, which are worked easily, which punch, bend, and are put in place and joined easily.

It permits, in short, the realization of a tank of iron, when the cost with the usual system would render it inadmissible. It is evident that this arrangement is of interest only with works of large size.

Discussion.

Mr. Salanson had assisted in the construction of several iron tanks, and was not at all of the opinion of Mr. Godinet when he said that the system is abandoned. It is still much employed in England. On the subject of accidents cited in France, he did not know whether the tanks were made in France or England, but it had been remarked that the builders in France did not follow the same methods as the English, who had a great habit of building them. He believed that the plates of cast iron should increase in thickness toward the bottom, and that the gasholder ought to be corded with bands crossing each other toward the base. There were several ways followed by builders. The best tank is that built in masonry. This one is the most durable, the most sure, and it is not always as costly as would be thought. He is not a strong advocate of sheet iron tanks, because he has found that all metal work demands attention and constant care. There are phenomena occurring at the base of a tank and operate for years, over which we can have no control; it is here he found danger in the metal. He preferred the masonry one, but he admired the new and very elegant system.

Mr. Godinet agreed with Mr. Salanson. It was not necessary to believe that because he read a paper on metal tanks that he considered them in all cases superior to masonry ones. There were cases where defect in foundation indicated metal to be preferred. So that if at Landy they could not put the pit in the ground, if they had put it above the weight of the walls would have been much greater, and have reached 30 feet. In relation to construction of cast and sheet iron, spoken of by Mr. Salanson, the largest known to Mr. Godinet had been made in Holland. They contained 640,000 to 700,000 cubic feet of water. These tanks are circled with iron hoops, but nothing has shown that the cast iron would have elasticity enough to prevent accidents.

The President asked permission to make some objections to what had just been said by his colleagues, M.M. Godinet and Salanson. The construction of masonry tanks, at least where the ground was not particularly even—rocky, for example—always presented chances of bad work; it is sufficient that the workmanship of several cubic feet of mortar or of the masonry should be entirely neglected, almost impossible to prevent at times, to cause a compromising of the strength of the work, and even of its solidity. Where the ground on which we build is bad, masonry tanks are always very costly, and of a durability very doubtful. So that actually strong tanks are very rare; in general there were two out of three which leaked. Now, these leaks where they occur may spread to the sources of water supply and cause lawsuits and damages. Cast iron tanks themselves prevent serious inconveniences. Cast iron is a metal which acts disadvantageously in traction; it may be affected by these conditions only by a coefficient of 4,200 lbs. per square inch. We are never sure of the homogeneity of cast iron (of the same scale as that of the plate), and among the multitudinous panels which form a tank it is difficult not to have some which have defects in the inside, almost impossible to recognize exteriorly. The adaptation of panels caused a very marked expense in the shape of drilling the rivet holes, sawing the bolts and planing the doors. The filling of the joints with the dust of the iron and the bolts is a source of danger, because if it is executed irregularly it may lead to abnormal strains which, added to the normal ones, might exceed the resistance of the metal. It was in this way that the accident to the gasholder at Versailles happened, to which Mr. Godinet made reference. The very serious accident, which led to the extinction of the furnaces, the destruction of the walls and the burning of a shed, was not the result of any fault in care or construction, since the plans were made by Mr. Servier, and the work conducted by him. It was able to cause a veritable disaster. The sheet iron presents the following important advantages? It is specially apt to resist strains; its defects when it has not been heated are almost always on the surface. If we take the precaution (easy to make) to punch the holes in concordance with the squared edge, the riveting produces no abnormal tension in the sheets, since it is necessary only to tighten them against each other. Sheet iron tanks have been reproached on account of their cost and danger of oxidation. Even under the conditions in which we build them, that is, in making the iron work under 8,400 pounds to the inch, they sell cheaper than masonry ones, since they can be put up under difficult conditions. But their price might be considerably diminished if we raise the coefficent of resistance designated by T in the formula given by Mr. Godinet, since the thicknesses to give the sheets and the weight of the construction are inversely as to the values of T. Is it possible to give T a value higher than 8,400 pounds without going against reason and prudence? I am persuaded it is so, and I ask permission to give the considerations and facts which work in its favor in my opinion. Having studied in 1878, for a society for which I was engineer, the construction of a large tank in moderately difficult conditions, I had advised against masonry and in favor of sheet iron. To render this less costly I had proposed to part with the routine coefficient 8,400 pounds, giving value to the following arguments: The coefficient 8,400 pounds is adopted in the construction of bridges and structures exposed to variations of temperature and to vibrations, and which are executed with iron of a quality inferior to that of the sheets used in gasholders. When a work is needed whose temperature may be considered practically as absolutely constant, because of the mass of water it contains, that is submitted to no kind of vibration, that is made of metal of a quality already selected, the coefficient may be very notably exceeded, and I proposed to accept that of 16,800. I ought to say that my advice was rejected, and I may add that the tank in masonry that they had brought numerous deceptions. Some years afterwards, another company adopted the project which had been refused, and a very responsible house undertook the responsibility of the construction of a metallic tank calculated with a coefficient of 12,600. They went a little further the same way, and worked with a riveting of 24 per square yard. Since then they have built a great many holders in which the coefficients have been varied from 7,000 to 13,600 for a sheet, and 15 to 17 per yard for the rivets; now none of these works has experienced the least accident. We must not lose sight of the fact that the formula giving the thickness of the sheets of a tank in relation to the height of the liquid, the density and diameter of the cylinder, supposes that this cylinder is a perfect solid of revolution, and takes no account of the eccentricity occasioned by the lapping of the plates. As the calculations which enter into it are complicated, we neglect it by diminishing the value of the coefficient of resistance. When we have to deal with tanks of considerable diameter, the effect of this eccentricity may be entirely neglected, and there is no reason for limiting ourselves to such diminution. The second fault found with tanks of sheet-iron is the pretended facility with which they oxidize. I believe it is not well founded. When we show fear on the subject of oxidation of plates it is certainly not for the exterior of the cylinder, since this is apparent and susceptible of stoppage. It relates then only to the interior surface of the bottom and exterior wall. It is remarkably easy to protect the bottom portion absolutely from all action of the air or moisture by a very simple artifice. It is only necessary to place it on a bed of pitch 1¼ to 1¾ inches thick, and slightly elastic, to fill the tank with water when it is about 6 feet high, and to cause this water to boil by steam pipes. The pitch softens and the bottom sinks into it, protecting it perfectly and efficiently. As regards the interior parts which are in contact with the water which is never renewed and which is deprived of air, there are conditions under which oxidation cannot take place. There would be an exception only in favor of the portion of the sheets above the plane of contact with the water. But these may be made separate from the rest of the cylinder and replaced when corroded, or what would be still better, make these sheets of galvanized iron.

The President added that having had to construct reservoirs for petroleum, of 35,000 cubic feet capacity, elevated on supports of masonry several yards high, and having believed it necessary to take special precautions for the constructions of so dangerous a nature, he asked advice of Mr. Contamin, Chief Engineer of Materials of the Northern Railway, and afterwards Chief Engineer of the metallic part of the Exposition. Mr. Contamin was of the opinion that under the conditions submitted to him, and which are reproduced in our gasholders, we could put the plates to a strain of 110,000 to 170,000 lbs.

Mr. Salanson thanked the President for the explanations given, which were very interesting; but he would like to say several words on the exposition he was going to make. It was his opinion when he said the sheet could be strained to 170,000 lbs. in special conditions, that was a matter of choice. The engineer should weigh all the conditions accom-

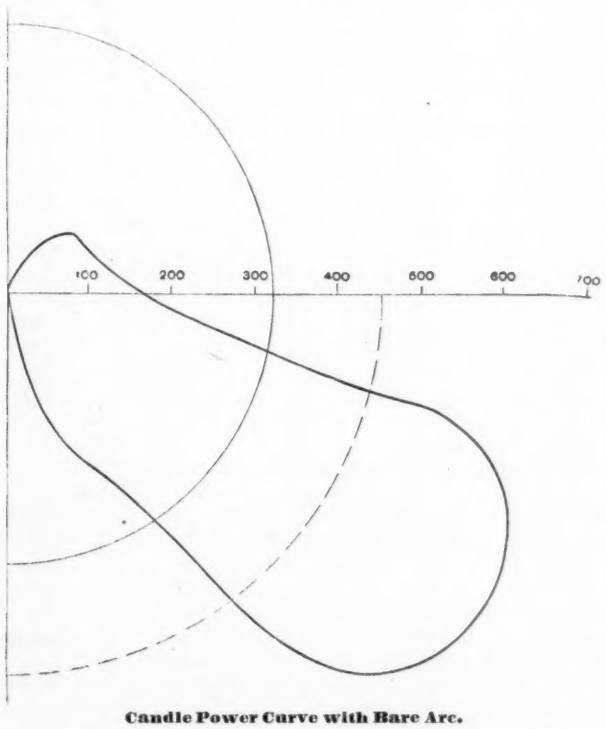
panying the nature of the work. It was a rule in roads and bridges to take a coefficient of security of one-tenth. We took 84,000 pounds. But the gasholders are not put to the same troubles as obtain in iron bridges. Mr. Salanson pointed out a little difference of opinion in the nature of the materials with which gasholders were built. Mr. Mallet said that two out of every three masonry tanks leaked, and he did not think iron tanks were in any sense dangerous, for we must not conclude that since one tank is badly built that the materials which were used in it should never be employed. The tanks at Versailles were badly built, and that was all that was proved by their collapse. We can make excellent tanks of cast iron, and there are examples of tanks in masonry which have lasted excessively long and are still perfectly sound. We must not decide that because one tank was badly made we must use neither cast iron nor masonry. As for sheet iron tanks, they have not the sanction of time long enough to drive out tanks of cast iron or of masonry.

The Loss of Light from the Use of Globes with Arc Lamps.

By Mr. George D. Shepardson.

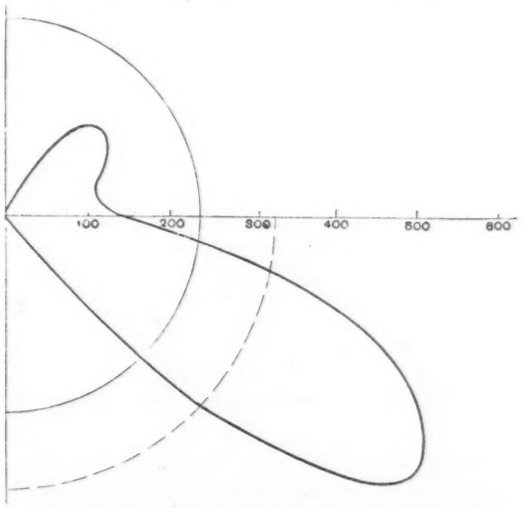
To the investigator, whether he be a student in the laboratory searching for new truths, or whether he be in charge of a central station or isolated plant, arc lighting presents many interesting problems. A renewal of interest in this important subject seems to have been arising during the past two or three years. The choice of dynamos, lamp mechanism, the size, shape and quality of carbons have been receiving a considerable amount of attention. Some thought also seems to have been given to the subject of globes. The importance of keeping these clean has long been recognized, but comparatively little attention seems to have been paid to the relative efficiency and desirability of different kinds.

Believing the subject of arc lamp globes to be a fruitful field for investigation, Messrs. J. D. Guthrie and F. E Reidhead, two of the seniors in the department of electrical engineering in the University of Minnesota, arranged a photometer for measuring the intensity and distribution of the light from an arc lamp with various globes and without any globe. In order to measure the light at different angles above and below the horizontal plane, the lamp was suspended from the end of a frame which could be rotated about an axis parallel to the photometer



Candle Power Curve with Bare Arc.

bar. A rotating mirror was placed on the photometer bar in such a position that by adjusting the mirror and the arm that carried the lamp the light in any direction from the arc would be reflected along the photometer bar, where it could be measured by a bunsen photometer. The principal point of difference between this device and that usually found in laboratories for similar purposes is that the adjustable mirror was about 16 inches in diameter. The reason for having so large a mirror was that the photometer might measure the light radiated from all parts of the globe and not merely that from the arc. A 16-candle power 50-volt lamp was used as a standard, having been previously calibrated with great care. The bunsen disc, with grease spot, gave fairly satisfactory readings of candle power after some practice. The arc lamp used was the Thomson-Houston ribbon feed type, adjusted to keep the potential as constant as possible. Current was supplied by a Thomson-Houston arc machine, regulated for 6.85 amperes. The standard incandescent lamp was shunted around a wire resistance in series with the arc



Candle Power Curve with Clear Glass Globe.

lamp. This was found to give a very steady and satisfactory light. The potential around the arc lamp and the incandescent was measured by means of a standard voltmeter and a double-throw switch. The current was measured by an ammeter previously calibrated.

The photometer was arranged so that the standard lamp might be moved in order to keep the car at a sensitive position on the bar. For some readings it was necessary to use the original standard of one candle power. Reflection from the floor and walls was prevented by placing between the arc lamp and the car a large screen, through which a hole about one foot in diameter allowed the direct light to pass while cutting off all extraneous light. The plentiful use of dull black tailor's pattern paper reduced the stray light to a minimum.

Having taken these precautions, the light from the arc was measured in different directions—

(*a*) With no globe,
(*b*) With a clear glass globe,
(*c*) With a ground glass globe,
(*d*) With an opal or white globe.

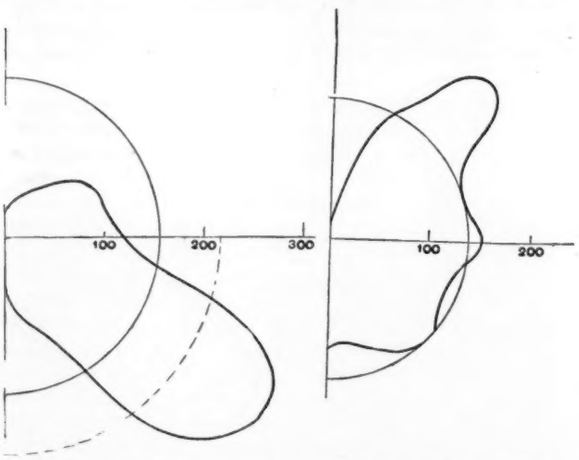
The average ten readings of candle power for each position is given in the following table of results :

Direction.	Candle Power. Bare Arc.	Clear Glass.	Ground Glass.	Opal Glass.
90° below	0	17	45	109
75° "	126	9	90	104
60° "	262	22	141	128
45° "	641	313	286	141
30° "	681	580	314	130
15° "	498	408	199	126
Horizontal	153	132	115	154
15° above	120	107	106	141
30° "	107	145	102	145
45° "	101	155	73	226
60° "	37	53	48	151
75° "	28	9	35	81
90° "	0	8	8	19
Mean spherical candle power	319	235	160	144
Mean hemispherical candle power	450	326	215	(138)
Average voltage	53.6	50.1	49.0	49.4
Per cent. spherical efficiency	100	53	23	19
Per cent. efficiency at maximum	100	82	47	(33) 16

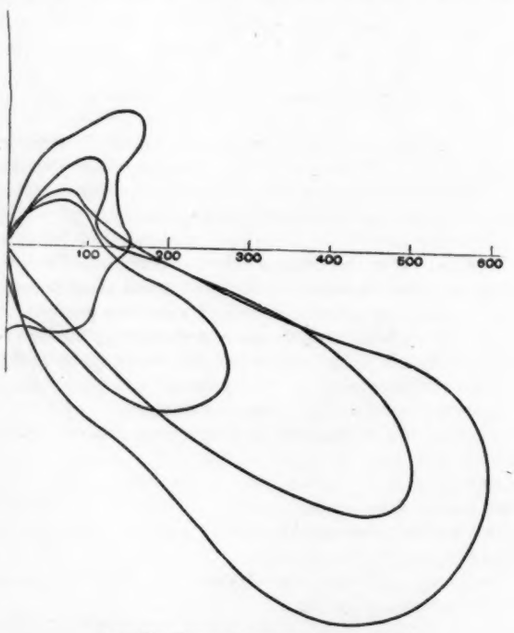
These figures are not exactly comparable, because the voltage was somewhat different for some cause not determined.

For obtaining the "mean spherical candle power," curves were plotted, showing the intensity of the light at various angles. The area of each curve was measured by a planimeter and a circle of equal area was

drawn. The radius of this circle gives the value of the candle power if the light were equally distributed in all directions. Since, however, in most arc lighting the downward light only is used, or principally so, it is preferable to obtain the "mean hemispherical candle power," or the equivalent value of the light, if equally distributed in all directions below the horizontal. This latter statement would, of course, be modified



Candle Power Curves with Ground Glass and Opal Globes.



Candle Power Curves Assembled.

in the case of interior lighting, especially if opal globes are used, or if the arcs are inverted so as to light by reflection from ceilings and walls.

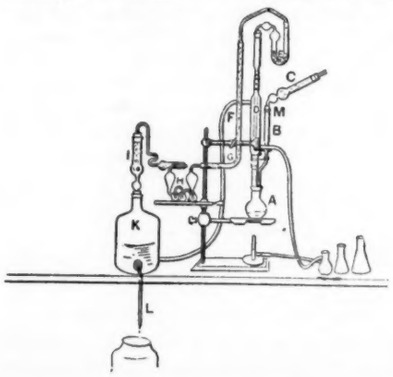
The amount of light transmitted by the different globes is given in percentages of the total amount given by the bare arc. The globes tested were obtained from the local lighting company through the courtesy of the Secretary and Manager, Mr. A. M. Robertson. These were taken from stock without any care to select good or poor ones.

The results of the test show that the amount of light absorbed by globes is no inconsiderable quantity. It is expected that this investigation will continue in order to determine the best kinds of glass to use, comparing various makes now on the market, and other problems. Interesting results are to be expected from a study of interior illumination by inverted arcs with and without metallic reflectors.

The above is to be considered only as a preliminary report of investigations upon an interesting and somewhat complicated problem.

Forbes Form of Apparatus for the Estimation of Carbonic Acid.

The form of apparatus for the estimation of carbonic acid devised by the writer and shown herewith, has been fully tested in our laboratories and found to be accurate, cheap, compact, easily portable, and applicable both to the estimation of carbonic acid in carbonates and to that of carbon in iron by the wet combustion with chromic and sulphuric acids. *C* is a tube, filled with solid potash, guarding the apparatus from the carbonic acid of the air. The small drop funnel *B* carries acid to the decomposing flask *A*. The small condenser *D* returns most of the water vapor, and the hydrochloric acid to the decomposing flask. The small U tube *E*, containing a solution of silver sulphate in sulphuric acid,



stops hydrogen sulphide and traces of hydrochloric acid. The drying tube *F G*, of ½ inch combustion tubing, and filled with calcium chloride, finally dries the carbonic acid gas before its absorption at *H*. The calcium chloride tube *I* guards the bulbs from moisture, and the aspirating bottle is discharged by the movable tube *L*.

When used for carbonates, a 50 cc. wide mouthed flask is best, but this must be replaced by a 250 cc. Erlenmeyer flask when making a wet combustion of carbon.

In practice it is found best, after the evolution flask is in position, to turn down the outlet tube *L*, and regulate the flow entirely from the stopcock *B*. Hydrochloric acid rarely gets beyond the condenser, and the downward pitch of the drying tube *F G* hastens the passage of the carbonic acid gas. The whole apparatus occupies less than 2 square feet of desk room.

Concerning Uniformity of Electrical Apparatus.

By Dr. Louis Bell, in *Electrical Reporter*.

My attention has frequently been called of late to the growing tendency among central station men toward insisting on strict uniformity of apparatus throughout their stations. Specially is this noticeable in planning new installations, and it is my purpose here to call attention to some of the disadvantages of carrying this frequently advantageous plan too far.

I have often been called upon to lay out a station consisting of machines identical in character and size for all purposes, arc lighting, incandescent lighting and motors. On its face the plan appears to be excellent, and it is certainly most convenient to be able to do all classes of work from one machine and to have such thorough interchangeability between all the machines that the supply of spare parts need be but small.

In many cases the scheme can be carried out successfully, for there are now on the market several polyphase systems, all modifications of the same general principle, by which we can do all sorts of lighting and all motor service, save railway service, quite successfully, and, in fact, the polyphase motor is for most purposes a better machine in itself than the direct current motor.

The incandescent lighting from polyphase machines is exactly equivalent to that obtained from ordinary alternators, and the same is true of the arc lighting, but right here our difficulty begins. The alternating arc lamp is not, at the present stage of its development, at all the equal of the direct current arc lamp for most purposes. It is in general too noisy for indoor work, is slightly less efficient as a light producer than the direct current arc lamp, and in the case supposed involves the use of distribution in parallel, a condition which affects the line unfavorably. Usually, too, it compels the use of a lower voltage than if the regular arc machines be used, for the cases are comparatively few where one would do general distribution with more than 2,500 to 3,000 volts on the line, while 60 and 80 light arc machines, and even larger sizes, are in quite regular use.

That central station will succeed best commercially that gives the best possible service and keeps its running expenses at a minimum. It therefore is questionable economy, for the sake of a comparatively small saving in interest on spare apparatus, which is undergoing no deterioration, to give an arc service unsatisfactory to the consumer, and do this at the cost of either additional copper, investment or lessened efficiency.

The case I have mentioned is only one of those in which diversity of apparatus tends to better and more economical service.

Consider a case quite common in central station practice. A station has been established near the densely populated portion of the city. Most of the incandescent lighting is within one-half mile of the station, while on the other hand there is quite a residence district scattered over a radius two or three times that mentioned. In the past it has frequently happened that under these conditions either a 3 wire or an alternating system would be installed and compelled to do the whole work. If the former, expense for copper or loss of efficiency in supplying the outlying districts is most formidable. If the latter, one is compelled for the sake of reaching a more distant point easily to distribute near the station by means of transformers at a considerably added expense, both in first cost and possible depreciation. This state of things should in nearly every case be met by the installation of both kinds of apparatus.

Suppose, again, we have to face the question of the direct coupled units now so popular. In very large stations the whole incandescent and motor service may be worked from direct coupled machines with advantage, but in four cases out of five, doing this means either the use of small units, with relatively uneconomical engines, or the operation of large units for a considerable portion of the time under very light load, and hence inefficiently. Under most circumstances, also, any attempt to direct couple arc machines involves very special apparatus, and again the use of comparatively small engine units.

It is well to remember in this connection that there is no mechanical appliance that is more thoroughly reliable and gives a better efficiency than a well made and well cared for leather belt. Under special directions direct couplings may be necessary to gain space, but its advantageous use is limited to those stations having a large enough service to permit the installation of good-sized units in sufficient number to avoid an unnecessary amount of spare apparatus and to permit the handling of the day load on a single unit or more, fully loaded.

All these considerations which I mention may seem quite obvious, but the principles of good practice are so often violated in these respects that it seems well worth while to call particular attention to the matter.

Each individual station requires specific treatment depending on the amount and character of the service to be performed, and the cases are relatively very few wherein the station most economical in first cost and in operation will also be composed of machines uniform in size and type.

In power transmission over very long distances we may frequently use a generating station composed of identical machines, but at the distributing station the same careful study of conditions is required as in an ordinary central station, and there is the same improbability that one method will do for everything. If one could foresee the development that is likely to take place in the service from a given station, it would be much easier to judge of the proper apparatus to be used. Nevertheless, in the majority of towns and cities of moderate size one can estimate without great difficulty the limitations that are likely to exist in the service, and should govern himself accordingly.

Another fallacy that should be considered is involved, in the remark which I have frequently heard: "Well, we don't know about this; in two or three years our machines may become obsolete, and we don't believe it is worth our while to put things on a permanent basis." The dynamo, as it is developed to-day, is a singularly efficient machine and the losses in it are understood as they were not understood 10 years ago. When we have a generator of 90 to 95 per cent. commercial efficiency at full load, we are getting pretty near the limit. There is no reason to expect that the conductivity of copper can be improved or that we shall be able to annihilate hysteresis in armature iron. Until we do these things we cannot very much raise the efficiency of our present machines, and the methods of construction now in vogue produce a dynamo which is not only highly efficient but subject to comparatively little deterioration if it is well cared for.

The experience of the last five years in central stations will bear out the truth of this statement, and although improvements will doubtless be made in the future as they have been in the past, there seems at present and so long as electrical service is carried out on anything near its present lines, small chance of getting machines so much more efficient and requiring so much less attention that it will pay to scrap the old ones and substitute the new.

The only contingency that could render our present apparatus valueless is some very radical departure in the methods of using electricity for lighting or power, and this contingency, although it exists, is not so closely impending that it ought to delay the putting of present stations on a sound working basis.

Study, then, the conditions that exist in each specific case, and study the apparatus to fulfil these conditions, as far ahead as you can see, in the best possible manner.

I cannot refrain here from saying a word about one probability which ought to have due influence.

There is a rapidly growing tendency toward the operation of central stations from some convenient water power within a reasonable range, the energy being electrically transmitted to the distributing station, and there either sent out on the lines directly or used to operate motors for replacing the steam engines previously in use. In a very large number of cases this can be done with advantage, the result showing immediately in lessening operating expenses.

In making additions to existing plants, or planning new ones, it is, therefore, wise to consider the possibility of such a change in method of operation, and to secure apparatus accordingly. In the case of installing new stations, it is highly desirable to take up the water power problem immediately, and in plants already existing the method deserves careful study. In a great many cases the best way of utilizing power will be found to be with motors driving the existing dynamos. If, however, a station through chance or foresight is arranged with reference to such a contingency, it is frequently possible to distribute current from the distant point directly on the existing system, and especially is this true where lighting only is to be done.

It behoves central station managers, therefore, to look well to it, if within reasonable reach—say 10 to 20 miles—of available water power, that their stations shall be susceptible of easy transformation into distributing points for a power transmission plant. This is merely a suggestion to be borne in mind in increasing or modifying central stations, and it calls in a general way for the use of alternating apparatus, whether single or polyphase, of somewhat lower frequency than has been generally used up to date. Such apparatus is generally not uniform with the rest of the existing plant, but its installation is rendered desirable for the reasons just given.

In closing, I may say that the only startling contingency which we may look forward to, without being charged with over-zealous enthusiasm, is the possible change which may come over our methods of distributing lighting. The present incandescent lamp as a light producer is terribly inefficient. Something like 19-20ths of the energy furnished the lamp is transformed into radiant energy of other forms than light. It does not seem reasonable to expect in the progress of electrical research such a wasteful state of things to continue indefinitely. It is not unreasonable to expect, at least within our lifetime, the production of 40 or 50 16 candle power lamps to the horse power, instead of 10 or 12. Not incandescent lamps, probably, but glow lamps of far greater luminous efficiency.

Such an improvement may be years in coming, or it may come like a thunderbolt out of a clear sky, in almost any year or month; but its coming is too uncertain to count upon, and even if all our hopes in this matter are fulfilled, the change, radical as it may be, can hardly be expected to involve arc lighting or motor service, and it may not be necessary to discard our present generators at all.

[The 6th of a series of lectures on the Chemical Technology of Coal Gas, by Prof. Vivian B. Lewes, F. I. C.]

The Consumption of Coal Gas for the Generation of Light.

Of all the many questions which at the present time affect the coal gas industry, there is probably none of more importance than the method by which gas is consumed. The Companies in London are tied down by the Legislature to supply gas of an illuminating power of 16 candles, and when we come to consider what this in reality means, we find that, by one of those subtle strokes of humor in which our legislative body occasionally indulges, it means to the consumer almost anything except a light equal to 16 candles. The amount of illumination which can be obtained by the consumption of coal gas is entirely dependent upon the method by which the gas is burned. From a so-called 16-candle coal gas the consumer rarely obtains a value of more than 12 candles per 5 cubic feet of gas consumed; while by using burners of rational construction, upwards of 40 candle illuminating power could be obtained for the same consumption of gas. In order to understand the causes which lead to this anomaly, we must first trace the actions which endow flames with luminosity; and, although a certain amount of doubt still exists on some of the minor details of the actions taking place in a luminous flame, the general course of the main causes which lead to luminosity are fairly clear, and we can obtain an insight into the methods best adapted for developing the highest possible amount of light from our gas.

In the year 1816 Sir Humphrey Davy, while engaged upon the cele-

brated researches which culminated in the discovery of the miner's safety lamp, noticed certain facts which led him to work out and propound his theory of the causes which lead to luminosity in flame—a theory which is generally stated as being that the presence of solid particles is essential to such luminosity. In 1868, however, this theory was attacked by Professor E. Frankland, in a paper read before the Royal Society, in which he showed that, although solid incandescent matter in a flame renders it luminous, luminosity is also in many cases produced when the flame contains very dense vapors at a sufficiently high temperature, and also that a non-luminous flame may be rendered luminous by increasing the pressure. This theory at once evoked considerable criticism, and for the next few years a large amount of work was done on the subject. Professor Frankland not only showed that flames might be luminous without containing solid particles, but advanced the theory that the luminosity of the flame of a burning gaseous hydrocarbon was due to dense hydrocarbon vapors. He also pointed out that the soot deposited on any cool surface held in the flame contained hydrogen. In answer to this, W. Stein showed that the deposited soot contained less than 1 per cent. of hydrogen, so that probably it was only occluded by the carbon; and that, if it had been present as vapor in the flame, it ought, on being heated to the same temperature as the flame, to be once again volatile, which is certainly not the case. Soret, in 1874, attempted to ascertain the truth of Frankland's theory by focussing the sun's rays upon a luminous flame, and examining the reflected light by means of a Nicol prism. He was followed by Burch, who, however, employed the spectroscope for his examination of the reflected light. The result of their experiments undoubtedly showed the presence of solid particles; and at the present time Davy's theory, as far as the flames of candles, oil and gas are concerned, is very generally accepted as the correct one.

While this discussion was going on Hilgard, Landolt, Blochmann and Heumann were devoting their attention to an examination of the chemical actions taking place in the flame, and the causes which lead to loss of luminosity when air is mixed with gas before consumption, as in the bunsen burner. Heumann found as a further proof to the "solid particle" theory that all flames which owe their luminosity to incandescent particles of matter give definite shadows, whereas those flames in which the luminosity is due to dense vapors give none; and that candle, oil and gas flames all give well-defined shadows. The work of Soret, Burch and Heumann proves beyond doubt that our ordinary illuminating flames contain, in the luminous zone, particles of solid matter; and the only solid which could be present is carbon, either pure or containing the merest trace of hydrogen. The chief question now remaining to be solved is consequently the action taking place which leads to the formation of the solid particles in the luminous zone of the flame.

The result of analyses made by Landolt of gases which were withdrawn from various parts of a coal gas flame, and also of a long series of analyses which I have made, show that, as the gas leaves the burner, the hydrogen is the first to be consumed, and that, in the passage up the non-luminous part of the flame, the carbon monoxide largely increases in quantity; while at the same time the methane rapidly decreases, and the unsaturated hydrocarbons seem to be the least affected. In the luminous zone, the unsaturated hydrocarbons rapidly disappear, while the carbon monoxide formed in the inner zone, and also the residual hydrogen and methane, undergo combustion. Professor Smithells, in a paper read before the Chemical Society in December, 1891, also proved that, during the incomplete combustion taking place in the inner cone of a bunsen flame, this same increase in the amount of carbon monoxide was to be observed. The fact that the decrease in quantity of the unsaturated hydrocarbons was but slow in the inner zone, and then took place with considerable rapidity in the luminous zone, favored the theory that they were broken up by heat in that portion of the flame, and liberated the carbon, which by its incandescence gave the luminosity. But it does not seem to have occurred to anyone to try and determine whether the unsaturated hydrocarbons at the top of the non-luminous zone were of the same description as those in the coal gas.

It is a matter of common observation that the checked combustion of a luminous flame at once gives rise to the escape of acetylene, and also that, if a bunsen burner catches light at the bottom, large quantities of acetylene are formed, the presence of which is at once detected by its distinctive and pungent odor. These facts suggested the idea that, in the inner cone of the flame, acetylene might be formed by decomposition of the original hydrocarbons. Experiment at once showed this to be the case. The gas was burnt at the end of an open tube; and the flame gases were aspirated from the center of the flame by means of a small platinum tube 2 mm. in diameter, and were led into a glass bulb tube, in which the sample for analysis of the total hydrocarbons was collected, and then through two Volhard's absorbing bottles, containing 20 c.c. of concentrated ammoniacal silver nitrate solution. This absorbed the acetylene, with formation and precipitation of silver acetylide and silver; the latter being formed owing to the reducing action of the carbon monoxide. Two absorbing vessels were quite sufficient to prevent any trace of the gas from escaping absorption. The contents of the two bottles were filtered, the precipitate of silver acetylide was carefully washed, and then treated on the filter very cautiously with dilute hydrochloric acid until all action ceases. Acetylene was given off, and the precipitate then consisted of silver chloride mixed with metallic silver. This, after washing, was digested with dilute ammonia; and the ammoniacal solution, after filtration, was treated with nitric acid to precipitate the chloride, which was weighed in the usual manner—1 gramme of silver chloride corresponding to 0.09 gramme or 87.03 c.c. of acetylene.

Acetylene Formed during the Incomplete Combustion Taking Place in the Interior of a Luminous Flame.

	Total Unsaturated Hydrocarbons. Per Cent.	Acetylene. Per Cent.
Gas in burner	4.38	0.035
½ inch above rim of burner	4.00	0.340
1½ inches " "	1.53	0.560
Tip of inner cone	1.98	1.410
Center of luminous zone	0.45	0.450
Tip of luminous zone	Nil.	Nil.

These figures show that in the interior of the luminous flame the hydrocarbons at once begin to decompose, forming acetylene, which, by the time the top of the inner non-luminous zone is reached, constitute over 70 per cent. of the unsaturated hydrocarbons present. A small proportion of the other hydrocarbons present remains undecomposed, and penetrates into the luminous zone, where it and the acetylene are both decomposed by the higher temperature attained. Carbon is liberated; and this, being for a moment heated to incandescence, gives luminosity to the flame.

The next analyses were taken from a flat flame—the gases being withdrawn and analyzed as before.

Acetylene Formed in the Inner Zone of a Flat Flame from a No. 7 Bray Burner.

Portion of Flame.	Total Unsaturated Hydrocarbons. Per Cent.	Acetylene. Per Cent.	Other Unsaturated Hydrocarbons. Per Cent.
½ inch from top of burner	3.565	0.115	3.450
1½ inches from burner	2.063	1.303	0.760
1¾ " "	1.393	1.133	0.260
2¼ " "	trace	trace	——

These figures show that, by the time the top of the non-luminous portion was reached, upwards of 81 per cent. of the hydrocarbon present had been converted into acetylene.

Luminosity in such a flame commences just above the 1¾ inches from the burner; and the question arises: If luminosity be caused by the acetylene, why should it not have commenced at 1½ inches, for in this place the acetylene is present in larger quantity than at the higher point? The answer to this is that, in order to obtain luminosity, a certain temperature must be attained, so as to decompose the acetylene; and the point at which this decomposition commences is the one where the luminosity of the flame starts. If this temperature is not reached, the acetylene in the presence of oxygen burns away with a non-luminous flame, or if no oxygen be present polymerizes into a number of higher hydrocarbons. But if the necessary temperature is reached, and the acetylene dissociates, the liberated carbon becomes incandescent, chiefly from its own combustion, and partly also from the combustion of the hydrogen liberated at the same time, and luminosity is the result. Accordingly, as the degree of dilution of the acetylene varies, so does the temperature necessary for its dissociation change. The more diluted it is, the higher the temperature needed; while with a large percentage of acetylene, a lower temperature is required for its dissociation, and the smaller, therefore, is the inner non-luminous zone of the flame.

Only from 1.1 to 1.3 per cent. of acetylene is found in the inner zone of a flame of ordinary coal gas, and, as this is in a highly diluted condition, it requires a temperature of close upon 1,200 C. to break it up; while in other flames, richer in hydrocarbons, and therefore richer in acetylene in the inner zone, the temperature required is not so high. For example—

	Flame of Coal Gas.	Flame of Paraffine Lamp.
Percentage of acetylene	1.133	2.222
Temperature at commencement of luminous zone	1,267° C.	1,062° C.

The fact that the acetylene burns away with a non-luminous flame unless the necessary temperature is attained is, I think, shown by the following experiment: The flame of burning alcohol contains more than half the quantity of acetylene a good gas flame does, and yet the combustion is practically non-luminous. If a dish containing some alcohol be placed under a bell jar, it burns with a flame having slightly luminous edges, and the temperature of the flame in this condition is 1,220° C. If now a glass plate be put over the mouth of the bell jar for a few moments, the mixing of the products of the air with the products of combustion lowers the rate of combustion, and the temperature of the flame falls to 1,050° C., the flame becoming perfectly non luminous. If, however, oxygen be admitted to the bell jar, the combustion is increased and the temperature rapidly rises to 1,510° C., the flame becoming nearly as luminous as a coal gas flame, and depositing carbon on any cold surface held in it. Again, if a small luminous gas flame be allowed to play on the bottom of a platinum dish, so much heat is ab stracted from the flame that the temperature falls below the point necessary to break up the acetylene, and the flame becomes non-luminous; while if the flame is allowed to remain in contact with the metal until the dish is red hot, the luminosity returns. The same effect may be produced by heating the interior of the dish with a blowpipe flame. This experiment was devised by Heumann to show the effect of cooling on luminosity. In every flame I have examined which owes its luminosity to the presence of hydrocarbons, these bodies are converted into acetylene before luminosity commences in the flame; and every gaseous hydrocarbon which can by heat be made to deposit carbon is converted into acetylene before any deposition takes place.

Many of the hydrocarbons present in coal gas are known to give out heat during their decomposition; but probably the most endothermic of these compounds is the acetylene—Thomsen having shown that no less than 55,010 units of heat are absorbed in the formation of 26 grains of acetylene, while only 10,880 units disappear in the production of 28 grains of ethylene. It is this which renders so easy its decomposition by heat, or, as shown by Berthelot, even by detonation, into carbon and hydrogen. The fact that acetylene is formed from the gaseous hydrocarbons present in illuminating gas prior to the emission of light does not, however, in any way, by itself, disprove Frankland's theory that luminosity is due to very heavy hydrocarbon vapors, and not to solid particles of carbon, as the well known tendency of acetylene to polymerize into higher bodies might be taken as the explanation of the presence of sufficiently dense hydrocarbons in a flame given by (say) pure ethylene.

In order to determine whether or not the acetylene formed in the earlier stages of the flame renders the flame luminous by liberating carbon during dissociation, as required by Davy's theory, or by forming heavier hydrocarbons, a long series of experiments was made to ascertain the effect of heat upon the hydrocarbons present in coal gas, and, by specially devised apparatus, to measure the actual temperature to which the gases were being heated, and to collect and analyze the resulting products. Ethylene passed at the rate of 4 to 5 c.c. per minute through a tube 2 mm. in internal diameter undergoes no apparent change until the temperature rises to between 800° and 900° C. It then breaks down to methane and acetylene; and, simultaneously with the formation of acetylene, heavy vapors appear which can be condensed, and in which benzine and naphthaline are conspicuous, as well as a heavy and highly fluorescent oil of high boiling point. Berthelot found that these substances were formed when acetylene was heated for some time at a temperature at which glass softens; and he also recognized among the products cinnamene (C_8H_8) and retene ($C_{18}H_{18}$). So that there seems very little doubt that, by passing the ethylene through a heated space in which the temperature does not rise above 900° C., methane and acetylene are first formed, and the latter at once polymerizes into the heavier hydrocarbons. The amount of acetylene found in the products of the experiments rarely exceeds 1 per cent., as the polymerization occurs almost simultaneously with the formation; but the proportion of ethylene decomposed, and the quantity of methane found in the products of decomposition, point to the initial action of heat at this temperature, being—

$$3C_2H_4 = 2C_2H_2 + 2CH_4.$$

When the temperature is raised from 900° to 1,000° C., the same action continues—no hydrogen appearing in the products of decomposition, and no carbon is deposited; but the formation of oil and solid hydrocarbons is more abundant. Between 1,000° and 1,100° C., a trace of hydrogen appears, and a little carbon begins to deposit with the oil; this increasing with rise in temperature up to between 1,300° and 1,400° C., by which time all formation of oil has ceased. Carbon is deposited in larger quantities; and the residual gas consists of hydrogen, with a little methane. The temperature at which oil disappears is about 1.200° C., and the proportion of acetylene formed at this temperature is larger than at any of the lower ones.

It is evident, therefore, that if the temperature existing in the luminous portion of the flame exceeds 1,200° C., the luminosity cannot be due to such hydrocarbons as are formed from the acetylene, but that carbon will be present in abundance. I have made several analyses of the carbon so deposited, and find that the hydrogen in it varies from 1 to 3 per cent.; and as there is no fixed ratio, I think there is not the slightest foundation for imagining it is in combustion. Indeed, Stein's work upon this point is fairly conclusive; and anyone who has attempted to prepare hydrogen-free carbon from sugar or any similar body, will realize the intense power which freshly liberated carbon has of occluding and holding hydrogen.

The temperatures existing in the flat flame in which I had traced out the changes taking place in the constituents of the gas, rapidly rise from 500° C., half an inch above the burner, to a little over 1,200° C at the commencement of the luminous zone—the luminous edges having a temperature of 1,216° C.; and these temperatures are further increased in the luminous zone until near the top of the flame 1,368° C. is reached. This at once gives us the secret of the luminosity. From the mouth of jet, and up to a temperature of 1,000° C. to 1,200° C., we have the formation of acetylene from the original hydrocarbons; but the moment the requisite temperature is reached by the combustion of the hydrogen and the carbon monoxide, the acetylene decomposes, with a further rise of temperature, and the carbon, heated to incandescence, radiates light and heat.

In the experiments with the hydrocarbons, the gases were passing through a heated space 6 inches long kept at a constant temperature, whereas in the flame they are passing through a space 1.75 inches long with a rapidly increasing temperature; so that, instead of the acetylene becoming polymerized to any great extent, it reaches a temperature at which dissociation takes place almost as soon as it is formed. Experiments with hydrogen-borne benzene vapor show that, at a temperature of 1,200° C. to 1,300° C., it is reconverted to acetylene; and this at once breaks down to carbon and hydrogen. The same happens with any other heavy vapors produced in the inner zone. These bodies formed probably in minute quantities by polymerization, together with any remaining methane, are reconverted into acetylene, and deposit their carbon as soon as the necessary temperature is reached; and this supplies a fresh quantity of carbon particles to the upper portion of the luminous zone, and so increases its size.

The careful analyses of Hilgard, Landolt and Blochmann, made to determine the interactions taking place in various flames, are, in their main characteristics, in close accordance with a long series and analyses of flame gases which I have made; and one of the most striking features of these is the comparatively slow rate at which the heavy hydrocarbons disappear, as compared with the other constituents of the original gas. This I find to be chiefly due to diffusion, which causes the hydrogen and methane to find their way to the outer skin of the flame first; and it is these bodies, therefore, which bear the brunt of the earlier combustion, and yield the heat which bakes the heavy hydrocarbons, ascending straight up from the burner, into acetylene. If three concentric tubes be placed half an inch above an open tube from which coal gas is issuing, and the gas from each is withdrawn and analyzed, it will be found that, on comparing them with the original gas, the action is most marked; the gas in the outer tube being practically a mixture of air with hydrogen, while in the inner tube the unsaturated hydrocarbons have risen from 3.56 to 4.53 per cent. All analyses of the flame gases show that the hydrogen burns first, and that next in rapidity of burning is the methane.

As may easily be imagined, the first burner used for the consumption of coal gas was the end of the tube from which it was issuing; but Murdoch, the "father" of gas lighting, soon saw that the consumption was far too high, and the illuminating value far too low, to make this a successful method of burning his new illuminant. Casting about to find a method of retarding the flow, he fitted an old thimble over the end of the pipe; and this happening to have several pin holes in the crown, he lighted the gas issuing from them to prevent it escaping into the room. He at once found that several small jets gave a far better light than one big flame, besides causing considerable economy in the consumption of gas. But as his experiments progressed, the form of his burner was modified, until in 1807, when fitting up the works of Messrs. Phillips & Lee, in Manchester, he used two forms of burner—the one a rough argand, and the other "a small curved tube with a conical end, having three circular apertures or perforations about $\frac{1}{16}$ of an inch in diameter (one at the point of the cone, and two lateral ones), through which the gas issuing formed three divergent jets of flame, somewhat like a fleur-

de-lys." The latter burner, which, from the shape of the jet, received the name of the "cockspur" burner, gave a light equal to 2¼ mould candles of six to the pound, while the argands used developed a light equal to 4 candles of the same description. The argand burner had been in use for the consumption of oils for some years before the introduction of coal gas; and in its early form it consisted simply of two concentric tubes fixed at the required distance apart—the coal gas being fed in between them. Soon, however, the idea arose of closing the open circular slot by a metal ring pierced with holes, so as to give a circle of small jets, and even prior to 1816 the main principles of our present argands were found to be in the burners in use. It was about 1816 also that the "cockspur" burner became converted into the "cockscomb," and then the "batswing;" thus marking a distinct advance in the method of burning the gas, as by spreading the flame out into a thin sheet, instead of having it in a solid mass as in the jet burner, the air was more readily and uniformly supplied to the burning gas, and the higher temperature of the flame, due to the more perfect combustion, increased the light-giving power of the burner to nearly that of the argands then in use.

In 1820, Nielson, of Glasgow, whose name will always be remembered as the discoverer of the hot air blast in iron smelting, found that, by allowing two flames to impinge upon one another, an increase in luminosity was obtained; and, after several preliminary stages, the union jet or "fishtail" jet was produced, in which two holes, bored at the necessary angle in the same nipple, caused two jets of gas to impinge upon each other, so that they mutually splayed themselves out into a flat flame. The batswing flame was a very wide one, of but little height, while the fishtail was much higher and narrower; and although the service yielded by the fishtail for each foot of gas consumed was no better than, even if it was so good as that given by the batswing, yet its shape, which made it less affected by draughts, and enabled a globe to be used with it, insured a greater meed of success for it than the batswing burner had secured. The next 20 years was a period of the gradual improvement and perfecting of the argand and flat flame burners—the influence of pressure and regulation of the flow of gas to the burner being gradually realized and arranged for, while other structural improvements were introduced.

On the 20th of May, 1853, Dr. Frankland, while giving one of the usual Friday lectures at the Royal Institution, showed, but did not fully describe, an argand burner in which the idea was first adopted of utilizing the heat which otherwise would have been lost, to raise the temperature of the air supply; and this burner was afterwards described in Ure's "Dictionary"—the article, however, not being published till a year or so after it had been written. The burner consisted of an ordinary argand; but, in addition to the usual chimney, it had a second external one, which extended some distance below the first, and was closed at the bottom by a glass plate, fitted air tight to the pillar carrying the burner, so that the air needed to support the combustion of the gas had to pass down the annular space between the chimneys, and in its passage became highly heated—partly by contact with the hot inner glass, and partly by radiation. The temperature of the air finally entering the burner Dr. Frankland considered to be about 500° F. In 1854, the Rev. W. R. Bowditch brought out a burner identical in nearly every respect with the one just described; and as this was brought prominently forward, it attracted considerable attention, with the result that the inception of the regenerative burner has been generally ascribed to Bowditch, while that honor is undoubtedly due to Frankland.

In 1879, Friedrich Siemens, of Dresden, brought out his large burner, which, although one of the most effective, was also one of the most unsightly from its big overhead feed pipe. This burner was really first made for heating purposes; but the light it gave was so far ahead of any effect which had been obtained up to that time, that, with certain modifications, it was adopted for lighting purposes. From that time up to the present, regenerative burners—good, bad and indifferent—have increased and multiplied with great rapidity; the chief differences between them being in their names and slight details of design. About the same time that the regenerative burner was struggling into prominence, Mr. Lewis brought out a burner in which the coal gas was consumed mixed with air, as in a bunsen burner; and the flame was then urged, by an artificial blast, against a cone of fine platinum wire, which, being heated to incandescence, gave a very high candle power per cubic foot of gas consumed. This was therefore the forerunner of the Welsbach, Clamond and other incandescent lights.

Having traced the gradual genesis of our present burners, we must now see how they comply with the theories I have laid before you. There are two special points to be observed to produce a luminous flame. First, to use a hydrocarbon that is easily converted into acetylene by means of heat; and, secondly, to have as hot a flame as possible. These two conditions now pointed out by theory have long been known in practice. Gas managers realize that the larger the quantities of olefines, etc., in their gas, the better its candle power; and burner makers have discovered that the regenerative burner gives by far the best results per cubic foot of gas consumed. But why, then, it may be asked, does high temperature retorting give such a poor gas, containing only a trace of acetylene. The reason is that acetylene, heated to a temperature insufficient to decompose it, polymerizes into bodies such as benzene, naphthaline, etc., which go to make the tar better at the expense of the gas. In fact, by passing coal gas through a heated platinum tube, I have been able to obtain naphthaline in considerable quantity; and at the same time the gas has deteriorated, so that superheating the gas itself during manufacture can only end in failure. But supposing it were possible to charge our gas with acetylene, it is so soluble in water or glycerine that it would nearly all be absorbed in the gasholder and meter, and very little would find its way to the burner. So we find that we must depend upon the gas flame itself for the production of acetylene. The luminosity of the flame results from having the acetylene formed in just the right place to be split up by the greater heat it encounters in passing up the flame.

We have two methods of raising the illuminating power of a gas—either by increasing the amount of acetylene forming gases (which is expensive), or by regeneration. Regeneration acts in two ways—first, by increasing the initial temperature of the flame. Then we have the blue zone decreased in size, because the temperature necessary to split up the acetylene is reached sooner, and therefore less is burnt without decomposition; also the higher the temperature, the more marsh gas is converted into acetylene. Secondly, the inert nitrogen of the atmosphere, being at a high temperature to start with, abstracts less heat from the flame; and therefore the carbon particles are heated to a higher state of incandescence. Through the kindness of Mr. Siemens, I have been enabled to measure the effect of regeneration on a flat flame. The flame when cold had an area of 11 square inches, the luminous portions of which occupied 7.8 square inches, and the non-luminous portions 3.2 square inches. On regenerating the flame, the area decreased to 10.2 square inches; but the luminous zone occupied 7.9 square inches, while the non luminous zone only occupied 2.5 square inches—the illuminating effect being more than doubled. But regenerative gas burners, on account of their initial cost, are but little used, at any rate for domestic purposes; and the flat flame burner is still the popular one. By the use of even the improved forms of flat flame burners, a great deal of the possible illuminating effect of the gas is lost.

Having now discussed the causes which lead to luminosity in flames, we are in a position to understand the enormous influence which the burner has upon the quantity of light obtained per cubic foot of gas consumed; and, on carefully testing the burners in ordinary use, we find that, for an equal consumption of gas, the results at once show the enormous advantage to be obtained by regeneration, and also how serious is the loss which attends the employment of ordinary burners.

Burner.	Light Obtained per Cubic Foot of 16-Candle Gas Consumed.
Regenerative	10.00 candle units.
Standard argand	3.20 "
Ordinary argand	2.90 "
Flat flame, No. 7	2.44 "
" No. 6	2.15 "
" No. 5	1.87 "
" No. 4	1.74 "
" No. 3	1.63 "
" No. 2	1.22 "
" No. 1	0.85 "
" No. 0	0.59 "

These burners were by well known makers; but there are plenty of cheap German nipples in the market which will give even worse results. In the above table, No. 7 is the largest flat flame burner given, as any larger size would never be used for indoor illumination; but with some of the big flat flame burners employed for outdoor work, as much as 3-candle power per cubic foot of gas is developed by the best make, while it is also quite possible to find cheap imitations of them, which can scarcely be distinguished by their appearance, only developing a little more than 1 candle per cubic foot. It seems probable that 10 candle units represent the maximum light to be obtained in practice per cubic foot from the so called 16-candle coal gas, as, although greater regeneration will increase it as high as 16 units, the heat is so intense that the burner is quickly destroyed. Taking 10 candle units as being the

amount of light for a consumption of 1 cubic foot of gas per hour, we can now form an approximate idea of the waste of illumination which attends the ordinary methods of burning the gas.

If the burners most commonly in use in houses be examined, they will be found to consist chiefly of No. 4 and No. 5 flat flame nipples; and I do not think I should be over-estimating the number in use if I put them at 85 per cent. of the total. The remaining 15 per cent. are made up of larger flat flame burners, argands and regenerative lamps, which give a higher service; but it will be found that the total value obtained will not exceed 2.5 candles per cubic foot. So that 75 per cent. of the total value obtainable from the gas is wasted, and for our present expenditure in coal gas we could obtain four times as much light.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE following is taken from advance sheets of the Ninth Annual Report of the Board of Gas and Electric Light Commissioners to the Massachusetts Legislature: "In November last the Hon. James W. McDonald resigned from the Board. In August last Hon. Charles A. Towne retired from the Board, his term of service having expired. There are now 134 Companies and individuals engaged in business under the supervision of the Board; 24 of these supply both gas and electric light. The corporate name of the Electric Light and Patent Flooring Company has been changed to Amesbury Electric Light, Heat and Power Company. The plant of the Middleborough Gas and Electric Company has been purchased by the town of Middleborough. The Berkshire Electric Light, Heat and Power Company has been organized. The Brookline Gas Light Company has extended its mains and is supplying gas to the city and to consumers in certain parts of the city of Boston, including the whole of that part formerly Roxbury. The Boston Gas Light Company and the Brookline Gas Light Company have during the year begun to supply water gas, and the Lowell Gas Light Company to supply water gas mixed with coal gas. The plant of the Lexington Gas Light Company for generating electricity for light has been erected, and the orders of the Board with reference thereto have been found to have been complied with. The work of the Board, in making the computations for its report, is interfered with by the delay of certain Companies in filing their reports. There were 30 delinquent Companies this year as against 45 last. Of these, 21 were filed in September; 6 in October; 2 in November; while that of one Company has not been filed at all. The Companies would help the Board if they would file their reports at as early dates as possible. There is no reason why all reports should not be in before the time limit fixed by law. The price of gas having been reduced by the different Gas Companies doing business in Boston, the Mayor, on November 9, sent a message to the City Council, from which the following is taken: 'Some question having arisen as to whether the citizens were receiving the full benefit of the reductions, I requested the City Engineer to inquire into the matter. These reductions should effect a saving of half a million dollars yearly in the gas bills of the 50,000 gas consumers of this city. The actual gas bills for the months of May, June, July and August, 1892, and for the corresponding four months of 1893, were procured for the following buildings, all situated in the territory formerly supplied by the Boston Gas Light Company exclusively, viz.: American House, Hotel Brunswick, New England House, Parker House, Quincy House, Revere House, Tremont House, United States Hotel, the Vendome, the Victoria, Young Men's Christian Union, C. F. Hovey & Co., Jordan, Marsh & Co., Macullar, Parker & Co., U. S. Custom House, U. S. Post Office, Young's Hotel, N. Y. and N. E. Passenger Station. It was found that the gas bills of these houses for the four months in 1892 amounted to $17,820.99, while the bills for the corresponding period of 1893 were $13,281.57, a reduction of $4,539.42, or almost exactly 25½ per cent. It thus appears that these particular consumers, whose experience may be assumed to have been representative of that of the people generally, received the full benefit of the reduction in the prices charged by the Boston Gas Light Company from $1.30 to $1 per 1,000 cubic feet.'" Then follows the report of the experiment conducted on similar lines by the Board on its own account, the particulars of which were commented on editorially in our issue for March 12.

A CORRESPONDENT, writing from Madison, Ind., under date of the 15th inst., reports: "The stockholders of Madison Gas and Electric Light Company, at their annual meeting, held on the 1st inst., elected the following Board of Directors: S. J. Smith, F. L. Powell, W. H. Powell, Chas. Johnson, C. E. Walker, H. B. Foster and James Somerville. The Directors met afterwards and elected the following officers: President, James Somerville; Secretary, H. M. Goold; Treasurer, F. L. Powell. The price of gas has been reduced, for illuminating purposes, from $1.80 to $1.50 net, and for fuel purposes to $1.25 per 1,000 cubic feet. It is the purpose of the Company to push the sale of gas for fuel and power. In this connection it might be interesting to state that the Company has recently erected a complete new gas and electric light works (except the gasholder) at a cost of $30,000, as the old works were liable to an occasional overflow from the Ohio river. The new works were built well above high water mark. The retort house contains three of Mitchell's improved benches of 5 retorts, with room for extensions. An exhauster house is attached to the retort house. The purifier house, with an ample and well lighted cellar, contains four 8 by 8 purifiers, with center seal; also, condensers and scrubbers. A neat station meter room is next the purifying house. Adjoining the meter room is the dynamo and engine room, containing a 600-light incandescent dynamo and a 50-arc light machine. The boiler room is large enough for two boilers; only one is in use at present. The benches, which are fired with cheap slack coal, were erected by the Laclede Fire Brick Company. The hydraulic main, condensers, scrubbers and purifiers were furnished and erected by the Kerr Murray Mfg. Company; the exhauster by the P. H. & F. M. Roots Company; and the station meter by Messrs. D. McDonald & Co. The capacity of the works is 100,000 cubic feet per day. The buildings were erected by a local builder, from designs by and under the supervision of Mr. Jas. Somerville, the well known engineer of the Indianapolis Gas Company."

SUPERINTENDENT GRAVES, of the Geneva (N.Y.) Gas Light Company, reports that the proprietors of the Company have authorized the adoption of the following rate schedule:

Monthly Consumption.	Gross, per M.	Net, per M.
4,000 cu. ft. or less	$2.50	$2.00
4,000 " to 6,000 cu. ft	2.50	1.75
Over " "	2.50	1.50

The old schedule was:

Monthly Consumption.	Gross, per M.	Net, per M.
Under 400 cu. ft	$2.50	——
400 cu. ft. to 1,000 cu. ft	2.50	$2.37
1,000 " to 2,000 "	2.50	2.25
Over 2,000 cu. ft	2.50	2.00

A comparison of the tables will show that the concession is an important one and should exert a marked effect on the Company's business.

THE following remarkable bill was introduced, in the New York State Assembly, on the 9th inst., by Mr. Robertson. It was read once and referred to the Committee on Electricity, Gas and Water Supply, where it will likely slumber and die, as it should:

An Act to prohibit the sale of water gas for illuminating purposes, and to prohibit the forcing of air in and through mains and pipes used for supplying illuminating gas and making a penalty therefor. The people of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. No person or corporation shall hereafter sell water gas for illuminating purposes or force air in or through mains or pipes used for supplying illuminating gas.

Sec. 2. Any person or persons violating any of the provisions of this act shall be deemed guilty of a misdemeanor and shall also forfeit the sum of $500 for each and every offense, to be recovered in an action in any court of competent jurisdiction, by any citizen in this State suing therefor, but not more than one action shall be brought for the same offense; each day's continuance of such unlawful act shall be deemed as a separate offense.

Sec. 3. This act shall take effect immediately.

THE following changes have recently been made in the clerical force of the Gas Bureau, Philadelphia: Samuel T. Spang to be Bill Clerk in the Spring Garden office, vice W. C. Lukens, who succeeds H. W. Smith as consumption clerk, the latter having been promoted to be Auditor. In the Frankford office Charles W. Bowers was appointed Bill Clerk, replacing D. P. Faunce, who was put in charge of the Registry desk.

MR. DICKERSON, Chief of the Cleveland (Ohio) Fire Department, is strongly opposed to the practice of placing gas meters in the spaces under stairways, and urges that the most appropriate location is close to the front cellar walls of buildings.

THE Board of Gas and Electric Light Commissioners of Massachusetts, in the case of the petition of the Mayor of Boston and certain named residents of the Charlestown and Somerville districts of Boston for a

reduction in the gas rate charged by the Charlestown Gas Company, have made the following decision: "This Company was organized in 1851, with a capital stock of $50,000. From that time to 1865 its capital stock was increased from time to time to $300,000, in part to meet the requirements of the business. It was the policy of the management, during this development, to issue stock dividends to represent the supposed increased values of its plant. This was done at a time when the true relations of a gas company to the community were not properly considered. In 1873 the present limit of $500,000 capital stock was reached. The last $200,000 of this amount seems to have been paid in, with cash, by the shareholders. Dividends of 10 per cent. per annum have been declared since January 7, 1886; prior to that time, 8 per cent. During the last period the Company has built a water gas plant and an electric plant, but it has charged off little to depreciation, and the amount of its notes payable has been gradually increased until it reached, December 31, 1893, $95,368. It will be necessary for the Company to spend a considerable sum upon its gas plant to enable it to give the best and most economical service to its consumers. The dividend rate heretofore paid by the Company has been higher than should have been paid by a company which has so largely capitalized its past earnings. If the conservative policy of putting earnings into plant, without an increase of the capital stock, had been adopted prior to 1865, the community would have been better and more economically served, and the Company would have to-day a real surplus, which would have been at once a strength to it and a benefit to its consumers. The capital charge is such a large element in the cost of gas that a distribution by a company of new capital amongst its shareholders, for which it had received no equivalent in permanent improvements, entails a burden both upon the company and the comsumers. The company should be so managed that it can keep pace with the requirements of the community, and make proper provisions for depreciation. In the past ten years if a more conservative dividend rate had been adopted, the now needed improvements to the plant could have been made and the community would now be getting the benefit of them, and it seems just, in view of the amounts which have been paid to the shareholders in the shape of dividends, that the last of the needed improvements should be largely borne by them, and that the price of gas should be fixed at a figure which contemplates a reduction in the dividend rate. Therefore,

"*Voted*, That the Board recommend that the net price of gas supplied on and after April 1, 1894, to the consumers of the Charlestown Gas and Electric Company shall not exceed $1.40 per 1,000 cubic foot, if paid on or before the 25th day of the month in which the bill is presented.

"*Voted*, That the Directors of the Charlestown Gas and Electric Company be requested to take action on the adoption of the following recommendation and transmit to the Board a certified copy of such action on or before March 31, 1894, and that the Clerk of the Board be directed to transmit to said Company a certified copy of the foregoing recommendation and the vote thereon."

THE rate at Charlestown is $2 gross, with 25 cents per thousand off, for prompt payment, and the average price received per 1,000 for all gas sold by the Company during 1891-92, as per the report of the Commissioners dated January, 1893, was $1.69, from which it will be seen that the concession ordered by the Commissioners is likely to result in a considerable decrease of revenue.

THE Pittston (Pa.) Gas Light Company will run a six-inch main from its works to the L. & B. Junction. No doubt this will add much to the Company's business.

HORACE NICHOLS, one of Bridgeport's (Conn.) most prominent citizens, died on the 13th inst. at his home in that city. Deceased, who was in his 82d year, was one of the original incorporators of the Bridgeport Gas Company, and remained a Director therein up to the time of his death.

MR. A. L. HAYDEN has been appointed book-keeper to the Citizens' Gas Light Company, of Willimantic, Conn.

SOME time ago a commission was appointed to name a price for the plant of the Citizens' Gas Company, of Wakefield, Mass., which the mupicipality proposed to take over and operate on public account. Some days ago the Commission notified the Town that it was ready to report, and would hand in the document as soon as it had received $4,500 for its services, one-half of which sum was to be paid by the town. A rather thrifty body, that; or is the town's credit not up to par?

IN response to the invitation of the local authorities, the Concord (N. H.) Gas Light Company offered to maintain 114 gas lamps, to burn 20 nights each month until midnight, at the rate of $16.50 per lamp; lamps to be maintained on the moonlight table to be paid for at the rate of $21; all night and every night lamps to cost $28.

THE Calumet and Hecla Mining Company has placed the order for a new iron building with the Berlin Iron Bridge Company, of East Berlin, Conn. The building will be 40 feet wide and 125 feet long, covered on the roof and sides with the Bridge Company's patent anti-condensation corrugated iron.

AT a special meeting of the Board of Managers of the Honesdale (Pa.) Gas Company, the following minute was unanimously adopted:

"In the death of the Hon. John Torrey we, the Managers of the Honesdale Gas Company, feel that we have met with a great personal loss. He has been connected with this Board for more than 35 years, ever since the organization of this Company, and for many years was the efficient Treasurer of the Company. Our association and intercourse with him as members of the Board of Managers have been very pleasant, and we desire to bear testimony to his constant courtesy, his excellent judgment, his thorough integrity and his unfailing interest in and devotion to the affairs of this Company. The success of the Company in the years that are past is largely to be attributed to the excellent business capacity of Mr. Torrey and to his thorough fidelity to his duties as an officer of the Company. We shall miss him greatly, both as friend and counsellor, from the meetings of our Board. To his children and grandchildren in their greater sorrow, we extend our heartfelt sympathy, and earnestly commend them to Him whose sympathies are infinite, and who knows how to administer comfort in every time of sorrow.

"It is directed that this minute be spread in full on the Secretary's book of the Company, that it be published in the newspapers of Wayne county, and that a copy thereof be engrossed and presented to the family of the deceased.—H. Z. RUSSELL, Secretary."

THE proprietors of the Scranton (Pa.) Gas and Water Company have made a written offer to sell to the city of Scranton the electric plant of the Company, by which the city is now furnished with electric lights, for $250,000. Of this amount $50,000 is to be paid down, the city to assume responsibility for $200,000 worth of bonds issued by the Company, which will mature in 20 years. The proposition was referred to the City Council.

MR. FREDERICK G. BURFIELD, Secretary of the Incorporated Gas Institute, writes us that the headquarters of the Institute have been removed to No. 13 Victoria street, Westminster, S.W., London.

THE Boston *Transcript* is our authority for the statement that the minority stock interest in the South Boston Gas Company, which has been opposed to the Bay State Gas Company, has sold out to the majority. The South Boston works will be immediately closed and the district supplied from other works. It is said the price paid was about $150 per share—the capital stock of the Company is $440,000—or about the price that was paid for the majority or control some years ago.

THE Committee on Manufactures of the Massachusetts State Legislature has reported favorably in the matter of the petition of the Brookline Gas Company to increase its capital stock to a sum not exceeding $2,000,000.

THE same Committee also granted leave to withdraw on the petition for legislation prohibiting gas companies from charging varying rates, framed on the quantity of gas sold.

THE Pintsch plant for the Southern Pacific Railroad Company, at Oakland Point, Cal., was put in operation on the 11th inst. The initial capacity of the plant is 12,500 cubic feet per diem, but is so arranged that by the expenditure of a comparatively small sum the output can be doubled.

A PINTSCH plant will also be erected at Indianapolis, Ind., the same to be operated by the Indianapolis Gas Company. It will be located on the latter's property at South and Delaware streets, and will represent an expenditure of $40,000.

THE Municipal Council of Victoria, B. C., has adopted an ordinance under which the sum of $55,000 is to be expended for the installation of a municipal electric lighting plant.

THE City Council of Wilkes-Barre, Pa., has awarded the following contracts on public lighting account, the contracts to run for three years from April 1st: 200 gas lamps to the Wilkes-Barre Gas Company, at

the rate of $20 per post per year, all night and every night; to the Wilkes-Barre Electric Light Company, 102 or more arcs, at the rate of $100 each per annum, the all night and every night table also to rule.

WE regret to chronicle the death of Mrs. Mary Byrne, mother of Mr. T. E. Byrne, Engineer to the Citizens Gas Light Company, of Brooklyn, N. Y. Deceased, whose demise occurred on the 18th inst., was in her 72d year. Interment was made on the 21st inst.

THE Weeks Gas Engine Company, of Lake Geneva, Wis., has been incorporated by Messrs. Henry A. Weeks, H. E. Harkins and Charles F. Case. It is capitalized in $5,000, that sum being named merely as a "starter."

WE are in receipt of a copy of the handsome and carefully compiled pamphlet that is being distributed by the Cicero (Ills.) Gas Company amongst the townspeople. The matter is of the commonsense sort, and is fully up to the purpose for which it is intended—the showing how to advantageously and economically use gas for lighting, cooking and heating. The pamphlet is profusely illustrated, one notable picture being a photographic reproduction of the Cicero Company's handsome office building at 115 North Oak Park avenue. A great many testimonials respecting the satisfaction which the users experienced in the service from their various gas apparatus are given, and another striking feature is a list of 435 householders—both names and addresses are given—who are using gas ranges.

MR. M. H. TAYLOR, who so successfully manages the great properties of the W. L. Scott estate, has declined to accept a nomination on the Republican ticket for representative in Congress from the 54th Pennsylvania district. The "call" to him was signed by hundreds of the most prominent men in Erie and Crawford counties, which is excellent testimony to his popularity and worth among those who know him best; but Mr. Taylor was constrained, on account of the many demands upon his time and attention, to say them "nay." The nomination is equivalent to an election.

ADVICES from Detroit, Mich., dated the 16th inst., are to the following effect: "The Hillsdale (Mich.) gas works have been sold by F. W. Stock to R. B. Owen & Sons, of Detroit, who will take possession April 1st. The Messrs. Owen say they will practically rebuild the old plant, putting in new steel mains in place of the present wooden ones, and extend the mains on streets now sufficiently built up to warrant such procedure. They will expend about $40,000 in improvements this season."

JOHN T. WOODRUFF is preparing foundations for a structure, to be located near Puritan Hall, Long Island City, at the instance of the Long Island Railroad Company, which Company proposes to there manufacture gas for lighting its passenger cars. While we are not sure of it, we nevertheless think it safe to say that the Pintsch system is to be the one employed.

SPEAKING or writing of Pintsch gas, the New York Central and Hudson River Railroad has undoubtedly taken away much travel from other competing roads through the general use of the Pintsch system of illuminating its passenger coaches. And this is especially so in respect of long distance travel.

THE Secretary of State of West Virginia has issued a certificate of incorporation to the Fairmount and Grafton Gas Company, of Fairmount, West Va., with an authorized capital of $300,000. The incorporators are Edward M. Grant, of Morgantown, W. Va., and James W. Rowland, Jacob J. Gosser, W. J. McConnell and Thos. B. Gregory, of Franklin, Pa.

THE Lafayette (Ind.) *Journal*, of March 15th, says: "Word received yesterday from Jas. Murdock announced the consummation of a deal by which the natural and artificial gas plants of this city pass into the hands of an Eastern syndicate headed by C. F. Dieterich and A. B. Proal. Negotiations have been in progress for some time and Mr. Murdock has been in New York for several days completing the details of the transaction. The price paid for the natural gas plant was $650,000, and the artificial gas plant brought $190,000. The total amount, $840,000, has been deposited in a New York bank and awaits the pleasure of the stockholders of the two Companies. It is probable that Samuel T. Murdock will be employed as manager of the natural gas plant, an arrangement that would certainly please all of the local patrons of the Company."

AN interesting fact is disclosed by the reports of the Transatlantic steamships landing passengers at this port of their business for 1893. According to the figures, these Companies carried, for the twelvemonth ended December 31, 1893, to the port of New York, 121,829 cabin passengers, or an increase for what is known as the Columbian Exhibition year of only 838 passengers, the figures for 1892 showing the transportation of 120,991 persons.

DIRECTOR WINDRIM and Chief Park recently furnished the Select Council Special Committee on Gas with some facts and figures about the gas plant of Philadelphia. The meeting was held in the Mayor's office in the presence of Councilmen Brown, Hetzel and Bringhurst. Mr. Windrim said that $2,591,000 would be required to put the works in first class condition, and that the city could then make gas at 37 cents per 1,000 cubic feet, or at any figure possible of attainment by any private enterprise.

WE regret to report the tragic death, on the 19th inst., of Mr. Richard W. Hardy, who had for many years been Superintendent of the Staunton (Va.) gas works, resigning therefrom in 1888. Mr. Hardy had been out hunting, and while walking along the tracks of the Chesapeake and Ohio Railroad, a short distance outside of Staunton, was struck by the locomotive of a passing passenger train and instantly killed. Deceased, who was born in Georgetown, D. C., was in his 74th year, and was a prominent and much respected citizen of Staunton.

Two "Hints" from President Smythe's Address.

At the annual meeting of the Southern District Association of Gas Engineers and Managers, held in England last month, an interesting inaugural address was delivered by the President, Mr. H. Smythe, of Maidstone. From it we abstract the following:

In this brief account of my experience, two matters are touched upon which I believe to be of more than usual interest to us at the present time. These are the "enrichment of gas by oil," and the "prepayment meter system of gas supply." From my own short experience of these, I have come to regard each of them as being an important departure in our industry, from which both gas consumer and gas purveyor are likely to derive considerable benefit. A substitute for cannel as an enricher of coal gas has long been desired, on account of its scarcity and dearness; and, judging from the fact that there are, I believe, very few members of this Association who are not using oil as an enricher in one way or another, this substitute has been found in oil, thanks to the cheapness and good quality of the article which can now be obtained for this purpose. Many engineers, like myself, find that carbureting gas with oil produces considerable economy in the ways I have mentioned; and as its extended use is sure to have a cheapening effect on the price of cannel, those who still resort to the latter as a gas enricher will, no doubt, likewise benefit by the innovation.

It is rather a curious coincidence that, while the use of oil is being largely adopted in gas works, a system of gas supply should be offered to the public, one of the direct consequences of which will be to displace the domestic use of a large quantity of oil of the same quality as that used for gas making purposes. This fact, by the way, should be reassuring to those who fear that its employment in gas works will greatly increase the demand for oil, and thus soon cause it to rise in price. That oil is not a safe illuminant is only too well known, and that it is otherwise unsatisfactory for this purpose is, I think, abundantly proved by the eagerness with which the prepayment meter system is taken up. Now that gas is to be had on terms which will suit the poorest laborer, it is likely to become more than ever the working man's light; and I think the time will soon follow when the working man will find the great benefit of gas as a heating as well as a lighting agent. That the system will meet a great want is, I think, shown by the following expressions of opinion, taken from the local press: One writer says that "its introduction will soon cause the dirt and danger proceeding from the use of oil lamps to become a thing of the past;" and another that "it will be a great boon to the working class, and is sure to meet with an ever increasing popularity." Mr. Frank Livesey, who has had considerable experience of the system, has recently said that it seems to have a great fascination about it; some people who can well afford to fit up their own houses preferring to pay a higher price for the gas, so that they pay for it beforehand.

This new system of gas supply creates another field for the extension of gas which is by no means an unimportant one, as, although each new consumer may be a small one, the number of them is likely to be very large, especially in the towns which this Association represents, where, in many cases, the supply to a few public lamps is the only consumption obtained in whole streets of workmen's houses. That this should be so is, of course, largely owing to the unpopularity of quarterly accounts, and to the inability of the working class to meet the initial expense of having their dwellings fitted for gas. As a means of avoiding the necessity for deposits and of preventing bad debts, the prepayment meter might also be supplied to many old consumers, to their great convenience and to the benefit of the gas suppliers; and from this system of gas supply I think we may look for a greater amount of business than we are likely to lose by the introduction of electric lighting.

The Market for Gas Securities.

As to-day (Friday) is a holiday on the Stock Exchange, we give the closing prices of last night, which show that Consolidated was bid for at 129, holders asking 130. On Thursday 200 shares were disposed of, the range being 130 to 130½. On Wednesday sales were made at as high a figure as 130⅞, and something over 1,000 shares were traded in. We look for much higher prices for Consolidated in the immediate future, since it seems to be understood that the Legislature will not interfere this year with gas rates. On this basis every city gas stock is cheap at current prices.

Brooklyn shares are strong at the advance of a week ago, but it seems to us there is a greater likelihood of profit in a sale of anything on the list than there would be in purchasing. There has been no further step in the conference line, and the Equity's conflicting interests are as inharmonious as ever. Chicago gas closed at 63⅛ bid, ex-div., of 1½ per cent., which is payable on and after April 2d. Baltimore Consolidated is strong, at 63⅞ to 64, and holders ought not to consider any offer for it under 75, which it will reach before mid-summer. Bay State is weak, at 23½ to 24, which decline is largely to be attributed to realizing sales. We note the following sales at auction: 120 Equitable, city, at 180½; 5 Metropolitan, of Brooklyn, at 130; 50 Buffalo (N.Y.) Mutual, at 121; and $1,000 Indianapolis gas, 6 per cent. bond, at 99. There was some inquiry in the early part of the month for San Francisco gas, which is fairly firm, at 65½ to 66½.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,
16 Wall St., New York City.

March 26.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share. ☜

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	128½	129½
Central	500,000	50	100	—
" Scrip	220,000	—	100	—
Equitable	4,000,000	100	182	184
" Bonds	1,000,000	—	106	108
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	145	150
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	80	95
" Bonds	150,000	—	—	100
Richmond Co., S. I.	348,659	50	50	—
" Bonds	100,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	—	35
Preferred	5,000,000	100	75	80
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	108	112
Citizens	1,200,000	20	55	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co	2,000,000	100	—	—
Bonds	1,000,000	—	—	—
Fulton Municipal	3,000,000	100	140	142
" Bonds	300,000		103	—
Peoples	1,000,000	10	—	80
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	98	100
Metropolitan	870,000	100	135	140
" Bonds (5's)	70,000	—	100	—
Nassau	1,000,000	25	160	—
" Ctfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	145	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Bay State Gas Co.—				
Stock	5,000,000	50	23½	24
Income Bonds	2,000,000	1000	60	—
Boston United Gas Co.—				
1s Series S.F. Trust	7,000,000	1000	78	—
2d " " "	3,000,000	1000	57	58
Buffalo Mutual, N. Y.	750,000	100	121	125
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
Chicago Gas Company.	25,000,000	100	66⅛	66¼
Chicago Gas Light. & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	81⅛	81½
Consumers Gas Light Co., Jersey City	2,000,000	100	25	30
Bonds	600,000	1000	84	87
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	184½	187
Central, S. F., Cal			—	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt	11,000,000	100	63⅞	64
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.—				
1st Mortgage	.....	.....	56	—
East River Gas Co., Long Island City	1,000,000	100	—	—
Bonds	500,000	100	89¼	—
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
Hartford, Conn	750,000	25	120	128
Jersey City	750,000	20	190	200
Louisville, Ky	2,570,000	50	125	130
Laclede Gas Light Co. St. Louis, Mo.—				
Common Stock	7,500,000	100	16	17
Preferred "	2,500,000	100	65	70
Bonds	9,034,400	1000	84½	85
Little Falls N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
Memphis (Tenn.) Gas	750,000	100	30	—
" Bonds	240,000	100	103	—
New Haven, Conn		25	200	—
Oakland, Cal			42⅝	43
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	108
2d "	2,500,000	1000	104	105
Peoples, Jersey City		—	160	170
" " Bonds			—	—
Paterson, N. J		25	99	102
Rochester, N. Y		50	80	85
Preferred			90	95
Bonds			90	95
Syracuse, N. Y	500,000	25	—	—
San Francisco Gas Co. San Francisco, Cal	10,000,000	100	65½	66
Washington, D. C	2,000,000	20	240	—
Wilmington, Del	500,000	50	180	182

Advertisers Index.

GAS ENGINEERS.

Jos. R. Thomas, New York City ... 451
Wm. Henry White, New York City ... 467
Fred. Bredel, New York City ... 463
H. C. Slaney, New York City ... 451
Geo. R. Rowland, New York City ... 451
Joseph P. Gill, New York City ... 451

CHEMISTS.

E. G. Love, New York City ... 463
Durand Woodman, New York City ... 451

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md ... 465
United Gas Improvement Co., Phila, Pa ... 457
Burdett Loomis, Hartford, Conn ... 467
National Gas and Water Co., Chicago, Ills ... 459
Economical Gas Apparatus Construction Co., Toronto, Ont. 458
The Western Gas Construction Co., Fort Wayne, Ind ... 458
A. M. Sutherland, New York City ... 458

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City ... 467
Continental Iron Works, Brooklyn, N. Y ... 466
Deily & Fowler, Phila., Pa ... 467
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 464
Stacey Mfg. Co., Cincinnati, Ohio ... 467
Bartlett, Hayward & Co., Baltimore, Md ... 465
Davis & Farnum Mfg. Co., Waltham, Mass ... 464
R. D. Wood & Co., Phila., Pa ... 466
Isbell-Porter Company, New York City ... 466
Fred. Bredel, New York City ... 463
United Gas Improvement Co., Phila., Pa ... 457
Berlin Iron Bridge Company East Berlin, Conn ... 454
National Gas and Water Co., Chicago, Ills ... 459
Economical Gas Apparatus Construction Co., Toronto, Ont. 458
The Western Gas Construction Co., Fort Wayne, Ind ... 458
C. Cunningham, Brooklyn, N. Y ... 452

GAS AND WATER PIPES.

Ohio Pipe Co., Columbus, Ohio ... 469
M. J. Drummond, New York City ... 469
R. D. Wood & Co., Phila., Pa ... 466
Warren Foundry & Machine Co., New York City ... 469
Donaldson Iron Co., Emaus, Pa ... 469
Addyston Pipe and Steel Co., Cincinnati, O ... 459
John Fox, New York City ... 469

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, New York City ... 463

GAS COALS.

Penn Gas Coal Co., Phila., Pa ... 461
Perkins & Co., New York City ... 460
Despard Gas Coal Co., Baltimore, Md ... 461
Westmoreland Coal Company, Phila., Pa ... 461

CANNEL COALS.

Perkins & Co., New York City ... 460
Log Mountain Coal, Coke and Timber Co., Pineville, Ky ... 461

GAS ENRICHERS.

Standard Oil Co., Cleveland, Ohio ... 461
The Sun Oil Co., Pittsburgh, Pa ... 461

COKE CRUSHER.

C. M. Keller, Columbus, Ind ... 461

INCLINED RETORTS.

Parker-Russell Mining and Mfg. Co., St. Louis, Mo ... 462

AIR COMPRESSORS.

Clayton Air Compressor Works, New York City ... 451

COAL TAR PUMPS.

Clayton Air Compressor Works, New York City ... 415

RETORTS AND FIREBRICK.

J. H. Gautier & Co., Jersey City, N. J ... 462
B. Kreischer & Sons, New York City ... 462
Adam Weber, New York City ... 462
Laclede Fire Brick Mfg. Co., St. Louis, Mo ... 462
Borgner & O'Brien, Phila., Pa ... 462
James Gardner, Jr., Pittsburgh, Pa ... 462
Henry Maurer & Son, New York City ... 462
Baltimore Retort and Fire Brick Co., Baltimore, Md ... 462
Parker-Russell Mining and Mfg. Co., St. Louis, Mo ... 462
Brooklyn Fire Brick Works, Brooklyn, N. Y ... 462
F. Behrend, New York City ... 451

CEMENTS.

C. L. Gerould & Co., Brooklyn, N. Y ... 462
F. Behrend, New York City ... 451

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y ... 451
W. C. Whyte, New York City ... 451

GASHOLDER PAINT.

The Government Waterproof Paint Co., Boston, Mass ... 465
New York Marine Paint Co., Poughkeepsie, N. Y ... 465

SCRUBBERS AND CONDENSERS.

G. Shepard Page's Sons, New York City ... 468
R. D. Wood & Co., Phila., Pa ... 466
James R. Floyd & Sons, New York City ... 468
Continental Iron Works, Brooklyn, N. Y ... 466

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md ... 465
Fred. Bredel, New York City ... 463
J. H. Gautier & Co., Jersey City, N. J ... 463
Parker-Russell Mining and Mfg. Co., St. Louis, Mo ... 462

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City ... 459
Wilbraham Baker Blower Co., Phila., Pa ... 459
Isbell-Porter Co., New York City ... 466

GAS GAUGES.

The Bristol Co., Waterbury, Conn..... 463

TAR AND CARBONIC ACID EXTRACTOR.

Geo. Shepard Page's Sons, N. Y. City..... 432

AMMONIA CONCENTRATOR.

Michigan Ammonia Works, Detroit, Mich..... 451

GAS METERS.

John J. Griffin & Co., Phila., Pa..... 470
American Meter Co., New York and Philadelphia..... 471
The Goodwin Meter Co., Philadelphia, Pa..... 472
Helme & McIlhenny, Phila., Pa..... 471
D. McDonald & Co., Albany, N. Y..... 471
Nathaniel Tufts, Boston, Mass..... 470
Maryland Meter and Manufacturing Co., Baltimore, Md.... 470
Harris Bros. & Co., Philadelphia, Pa..... 470
Metric Metal Co., Erie, Pa..... 469

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Company, New York City..... 466
Continental Iron Works, Brooklyn, N. Y..... 466

BURNERS.

C. A. Gefrorer, Phila., Pa..... 451
Moses G. Wilder, Phila., Pa..... 451

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn..... 451

STREET LAMPS.

J. G. Miner, Morrisania, New York City..... 463
Bartlett Street Lamp Mfg. Co., New York City..... 463

PURIFYING MATERIAL.

Connelly Iron Sponge and Governor Co., New York City... 459
Greenpoint Chemical Works, Brooklyn, N. Y..... 459
Henry W. Douglas, Ann Arbor, Mich..... 459
Read, Holliday & Sons, Ltd., New York City..... 451

ELECTRICAL APPARATUS.

Wm. Henry White, N. Y. City..... 467
Fort Wayne Electric Co., Fort Wayne, Ind..... 339

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind..... 456
Isbell-Porter Company, New York City..... 466
Wilbraham Baker Blower Co., Philadelphia, Pa..... 459
Connelly Iron Sponge and Governor Co., New York City.... 459

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y..... 465
Chapman Valve Manufacturing Co., Boston, Mass..... 465
R. D. Wood & Co., Phila., Pa..... 466
Continental Iron Works, Brooklyn, N. Y..... 466
John Fox, New York City..... 469
The P. H. & F. M. Roots Co., Connersville, Ind..... 456
Isbell-Porter Co., New York City..... 466

GAS ENGINES.

Schleicher, Schumm & Co., Phila., Pa..... 436

ENGINES AND BOILERS.

The Hazelton Boiler Co., New York City..... 433

PURIFIER SCREENS.

John Cabot, New York City..... 463

GAS STOVES.

American Meter Co., New York and Philadelphia..... 455
The Goodwin Meter Co., Phila., Pa..... 472
George M. Clark & Co., Chicago, Ills..... 453
Maryland Meter and Manufacturing Co., Baltimore, Md.... 470
The Schneider & Trenkamp Co., Cleveland, O..... 452

PATENTS.

H. B. Willson & Co., Washington, D. C..... 451

Engagement Desired.

A Gas Engineer

of 20 years' experience in the manufacture of coal and water gas, and in the building and general superintendence of works, desires an engagement. Satisfactory references can be given.

Address "ENGINEER,"

981-4 Care this Journal.

Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to

STROH & OSIUS, Pat'ees, or

Mich. Ammonia Works, Detroit, Mich

AIR COMPRESSORS

For Compressing Gases, Testing Purposes, Operating Oil Burners under Furnaces, and every other Purpose.

COAL TAR PUMPS.

Send for Catalogue.

CLAYTON AIR COMPRESSOR WORKS,

26 Cortlandt Street, New York.

DURAND WOODMAN, Ph.D.,

Analytic and Technical

CHEMIST.

Fuel and Gas Coals, Gas, Materials for Purification, Water, etc.

Laboratory, 127 Pearl (80 Beaver) St. N. Y.

PATENTS

Promptly secured. Trade-Marks, Copyrights and Labels registered. Twenty-five years experience. We report whether patent can be secured or not, free of charge. Our fee not due until patent is allowed. 32 page Book Free.

H. B. WILLSON & CO., Attorneys at Law, Opp. U. S. Pat. Office. WASHINGTON, D. C.

JOS. R. THOMAS,

No. 32 Pine Street, N.Y. City.

CONSULTING AND CONSTRUCTING

Gas Engineer and Contractor.

PLANS, SPECIFICATIONS, AND ESTIMATES FURNISHED.

Contracts taken for all Appliances required at a Gas Works,

Either for New Works or Extensions to Old Plants.

H. C. SLANEY,

Gas Engineer

466 Sixth Street, Brooklyn, N. Y.

Plans, Specifications and Estimates furnished for New Works, Alteration or Extension of Old Plants.

JOSEPH P. GILL,

GAS ENGINEER,

59 Liberty St. (Room 31), N. Y. City.

Plans, Estimates and Specifications furnished for new works, Coal or Water Gas, and for alterations and extensions.

GEORGE R. ROWLAND,

Formerly with the Continental Iron Works.

Draughtsman and Constructing Engineer.

Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.

Office, No. 245 Broadway, N. Y. City.

Read, Holliday & Sons, Ltd.

No. 7 Platt St., N. Y. City.

HYDRATED OXIDE OF IRON

For Gas Purification.

Analysis, Samples and Particulars on Application.

F. BEHREND,

SOLE IMPORTER OF THE CELEBRATED

German (Stettin-Didier) Clay Gas Retorts,

BLOCKS, TILES, FIREBRICKS, FIRE CEMENT,

Stettin "Anchor" & "Eagle" Brand Portland Cement

10 & 12 Old Slip, New York.

Gasholder Tank Construction, Etc.

Gas Companies and others about to erect Gasholders will find it profitable to consult W. C. Whyte, who for over 30 years has made a specialty of

Tank Excavation & Mason Work.

Fifty tanks now in operation show the sort of work done.

W. C. WHYTE, 136 Liberty St, New York.

GASHOLDER TANKS AND GAS WORKS MASONRY COMPLETE.

Plans prepared and Estimates furnished at short notice.

J. P. WHITTIER,

70 Rush St., Near Division Ave., Brooklyn, N. Y.

MOSES G. WILDER,

Mechanical Engineer,

816-822 Cherry St., Phila., Pa.

MANUFACTURER OF

Gas Governors,

Governor Gas Burners,

Gas Cocks and Fittings,

In addition to a full assortment of Volumetric Governors, etc., I am now making **MERCURY PRESSURE GOVERNORS** of all the usual sizes, adapted to use upon *Gas Stoves, Furnaces, and Meters.* The same careful attention to details of design and workmanship which has established the reputation of **WILDER'S VOLUMETRIC GOVERNORS** will be given to the new line. They have been thoroughly tested in many places during the past year, and have given entire satisfaction. The price is very low, and but for a complete system of machinery adapted to this work, it would be impossible to sell them at the price. I hope for large orders, as they become known, in consequence of the low price and good quality.

Patent Lava Gas Tips.

UNIFORMITY GUARANTEED.

ALL SIZES AND SHAPES.

D. M. STEWARD MFG. CO.,

CHATTANOOGA, TENN.

To Gas Companies.

We make to order **CAP BURNERS** to burn any amount under a stated pressure. Send for samples.

Also, SERVICE CLEANERS, DRIP PUMPS, and STREET MAIN PROVING APPARATUS.

C. A. GEFRORER,

248 N. 8th St., Phila., Pa.

NAPHTHA TANK CONSTRUCTION A SPECIALTY.

Gas Companies intending to erect

Tanks for Naphtha Storage

ought to communicate with

CHRISTOPHER CUNNINGHAM,

Proprietor of the

Novelty Steam Boiler Works.

Best Material and Best Workmanship at Lowest Possible Rates. Refers by permission to the Boston Gas Light Company, the Worcester, Mass., Gas Company, and dozens of others.

Greenpoint Avenue and Newtown Creek, - - - BROOKLYN, N. Y.

RELIABLE GAS STOVES AND RANGES FOR 1894.

Seven Distinct Lines.

Ninety-six Different Styles.

Ranging in Price from $3.00 to $78.00.

SEND FOR 1894 CATALOGUE OF GAS RANGES.

WE HAVE ADDED AN ENTIRE NEW LINE OF CHEAP GAS RANGES FOR 1894.

Also Five Lines with Side Broiler.

New Designs and Improvements for 1894. The Largest and Most Complete Line Ever Manufactured under one name.

THE SCHNEIDER & TRENKAMP CO.

479-501 Case Ave., Cleveland, Ohio.

Sole Manufacturers of Reliable Gas Ranges.

JEWEL GAS STOVES

Are Unequaled.

The New No. 393. $53.00.

For 1894.

78 Styles,

Listing from 75 Cents to $68.00.

Send for Catalog.

Reduction in List.

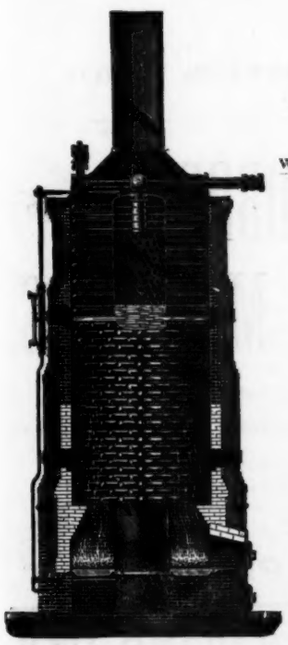
George M. Clark & Company,

MAKERS,

149-161 Superior Street, Chicago.

The HAZELTON BOILER Frequently Called The PORCUPINE BOILER

Patented in America and Abroad.



UPWARDS OF

100,000 HORSE POWER

of this Justly Celebrated Water-Tube Boiler in Successful Operation in all the Principal Industries.

An Unparalleled Record of many years for Economy, Durability, Safety and Efficiency.

A Common-Sense High-Pressure Boiler made in a Superior Manner in Our Own Works.

We Solicit for it the Critical Examination of the Mechanical Profession and the Steam-Using Public.

THE HIGHEST STANDARD OF EXCELLENCE.

Standard Sizes, 50 H.P. to 500 H.P.

THREE REGISTERED
THE HAZELTON BOILER.

THE PORCUPINE BOILER.
TRADE MARKS.

Special Waste-Heat Boilers for Rolling and Other Mills.

All Genuine Boilers of this Type bear our Three Registered Trade Marks.

BEWARE OF IMITATIONS.

Write for Illustrated Catalogue. Correspondence Solicited.

This Company is prepared to Manufacture and Furnish Plants of Boilers of any desired capacity, and will forward proposals and other information on application. All imitations of the substantial features of this Boiler are infringements, and will be prosecuted to the full extent of the law.

ESTABLISHED 1881. INCORPORATED 1888.

FOUNDED BY JOHN P. KENNEDY & SONS.

E. S. T. KENNEDY, President.
W. T. KENNEDY, Vice-President.
J. B. REEVE, Secretary.

THE HAZELTON BOILER CO., Sole Proprietors and Manufacturers 716 E. 13th St., New York, U.S.A.

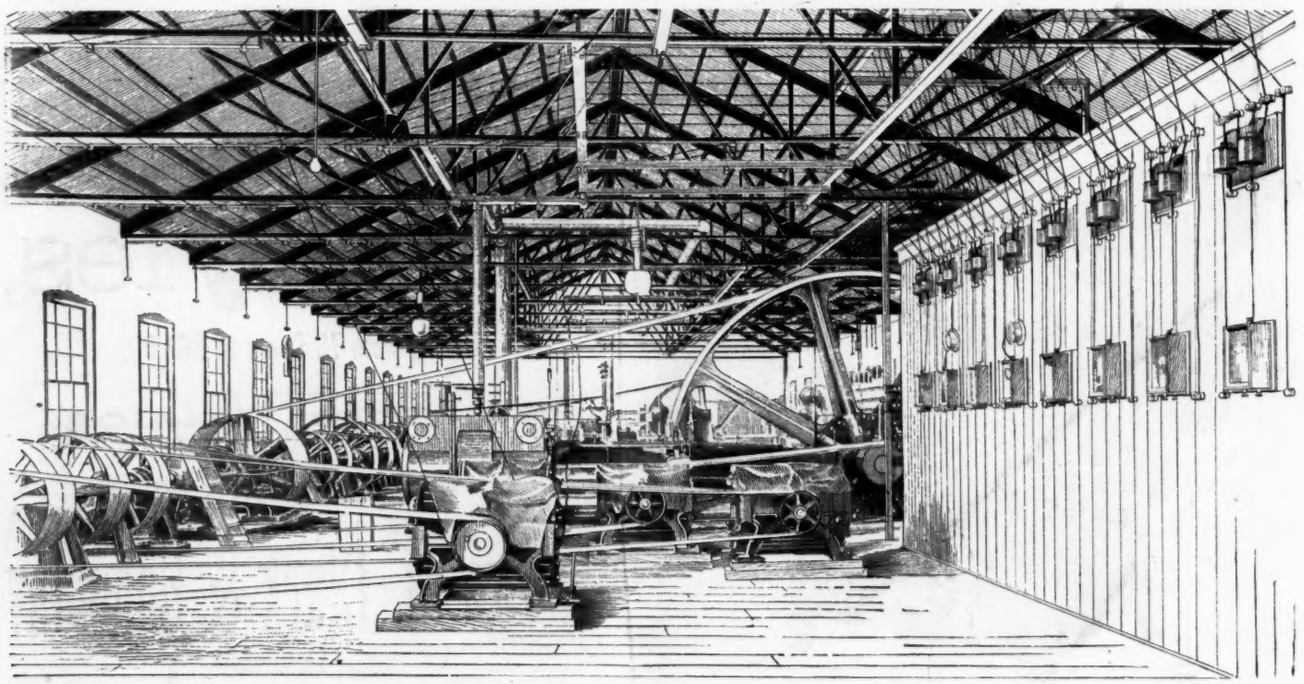
The Original and Only Manufacturers of this Type of Boiler. Cable Address, "PAILA," New York. Long Distance Telephone, 1229-18th St., New York.

This Boiler is producing unequaled results in the works of many of the principal Gas Co.'s of the U.S., and in similar plants in Foreign Countries.

NOT CONNECTED WITH ANY OTHER CONCERN IN THE UNITED STATES.

CHAS. M. JARVIS, Prest. & Chief Engineer. BURR K. FIELD, Vice-President. FRANK L. WILCOX. Treasurer. GEO. H. SAGE, Secretary.

THE BERLIN IRON BRIDGE CO.



The above illustration is taken direct from a photograph, and shows the construction of an Iron Truss Roof designed and built by us for the Connecticut Electric Company, at Waterbury, Conn. The building is 51 feet in width by 251 feet in length, with brick walls and iron truss roof covered with corrugated iron. For an Electric Light Station, where the risk from fire is very great, this construction particularly commends itself, as this risk is entirely eliminated.

Write for Illustrated Catalogue.

Office and Works, No. 6 Railroad Avenue, East Berlin, Conn.

Fuel and Its Applications

By E. J. MILLS, D.Sc. F.R.S., and F. J. ROWAN, C.E., assisted by others, including Mr. F. P. Dewey, of the Smithsonian Inst., Wash., D. C.

PLATES, AND 607 OTHER ILLUSTRATIONS. ROYAL OCTAVO, PAGES XX, 802. HANDSOME CLOTH, $7.50.

A. M. CALLENDER & CO., 32 Pine St., N. Y.

BOOKS.

DISTILLATION OF COAL TAR AN AMMONIACAL LIQUOR.

By GEORGE LUNGE. Price $12.50.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS.

By DAVID A. GRAHAM. 8vo., Cloth. Price $3.

Orders for these books may be sent to this office.

A. M. CALLENDER & CO.,
42 PINE ST., N. Y. CITY

NEWBIGGING'S HANDBOOK FOR GAS ENGINEERS AND MANAGERS.

The present (the fifth) edition marks an important advance on those that have gone before. Considerable additions have been made to the text and much of it has been rewritten and otherwise improved.

Price, Cloth, $6.

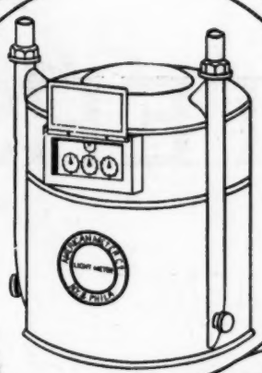
A. M. CALLENDER & CO., 32 Pine St., N. Y.

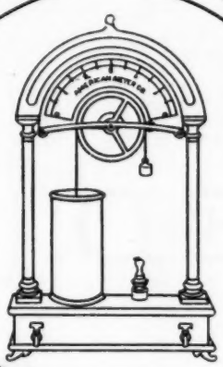
THE CHEMISTRY OF ILLUMINATING GAS.

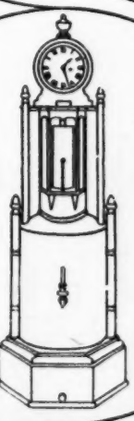
By NORTON H. HUMPHRYS. Price, $2.40.

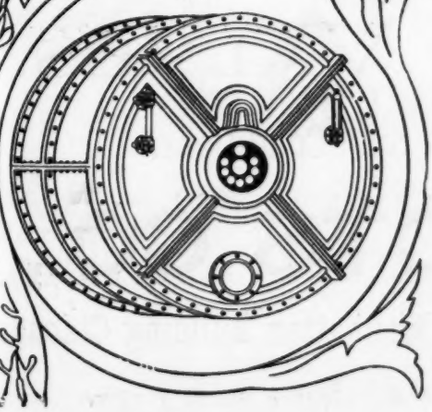
Orders may be sent to

A. M. CALLENDER & CO., No. 32 Pine Street, New York City.









AMERICAN METER CO.

ESTABLISHED 1834. INCORPORATED 1863.

NEW YORK and PHILADELPHIA.

CHICAGO, CINCINNATI,

ST. LOUIS, SAN FRANCISCO.

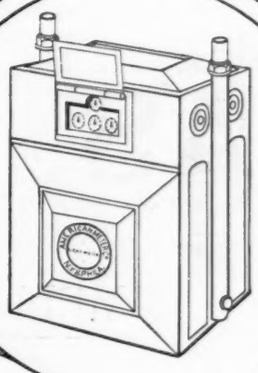
PUBLIC LIGHTING TABLE.

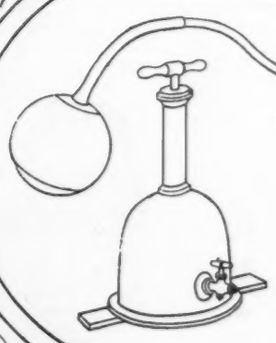
APRIL, 1894.

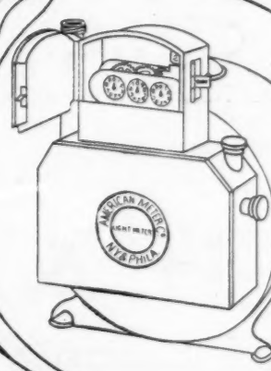
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. Extinguish.
				P.M.	A.M.
Sun.	1	6.50 PM	4.40 AM	6.10	4.55
Mon.	2	6.50	4.40	6.15	4.40
Tue.	3	7.00	4.40	6.15	4.40
Wed.	4	7.00	4.40	6.15	4.40
Thu.	5	7.00 NM	4.40	6.15	4.40
Fri.	6	7.00	4.40	6.15	4.40
Sat.	7	7.00	4.30	6.15	4.40
Sun.	8	7.00	4.30	6.15	4.40
Mon.	9	7.00	4.30	6.25	4.30
Tue.	10	11.20	4.30	6.25	4.30
Wed.	11	12.20 AM	4.30	6.25	4.30
Thu.	12	1.10 FQ	4.30	6.25	4.30
Fri.	13	1.50	4.30	6.25	4.30
Sat.	14	2.20	4.20	6.25	4.30
Sun.	15	2.50	4.20	6.25	4.30
Mon.	16	3.10	4.20	6.30	4.20
Tue.	17	3.30	4.20	6.30	4.20
Wed.	18	No L.	No L.	6.30	4.20
Thu.	19	No L. FM	No L.	6.30	4.20
Fri.	20	No L.	No L.	6.30	4.20
Sat.	21	7.10 PM	9.50 PM	6.30	4.20
Sun.	22	7.10	10.50	6.30	4.20
Mon.	23	7.20	11.50	6.40	4.10
Tue.	24	7.20	12.50 AM	6.40	4.10
Wed.	25	7.20	1.30	6.40	4.10
Thu.	26	7.20	2.20	6.40	4.10
Fri.	27	7.20 LQ	2.50	6.40	4.10
Sat.	28	7.20	3.20	6.40	4.10
Sun.	29	7.20	3.40	6.40	4.10
Mon.	30	7.20	4.00	6.45	4.00

TOTAL HOURS LIGHTING DURING 1894.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	244.10	January	423.20
February	195.30	February	355.25
March	206.20	March	355.35
April	169.40	April	298.50
May	162.10	May	264.50
June	135.40	June	234.25
July	146.30	July	243.45
August	162.20	August	280.25
September	174.10	September	321.15
October	211.20	October	374.30
November	221.00	November	401.40
December	245.30	December	433.45
Total	2274.20	Total	3987.45







ROOTS' GAS EXHAUSTERS.

IN POINTS OF

SIMPLICITY, DURABILITY, EFFICIENCY,

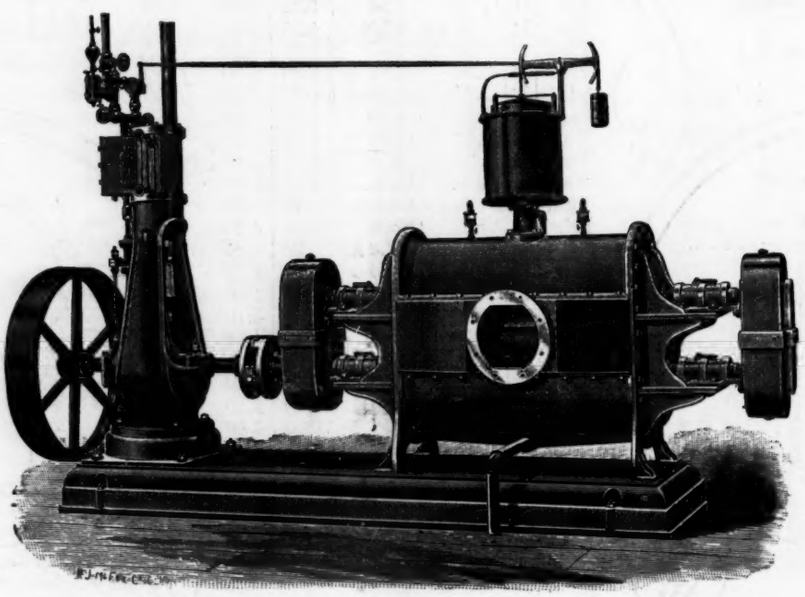
ECONOMY OF POWER, NEATNESS OF DESIGN,

MECHANICAL CONSTRUCTION,

THEY ARE

UNEQUALED.

Inquiries Cheerfully Answered.



Send for Catalogue.

BYE-PASS AND GAS VALVES.

Pipe Fittings of all Kinds and Designs to Suit Conditions.

P. H. & F. M. ROOTS CO.,

Home Office, Connersville, Ind. **Branch Office, 501 Manhattan Building Chicago.**

S. S. TOWNSEND, Gen. Agt., COOKE & CO., Selling Agts., 163-165 Washington St., N. Y. City.

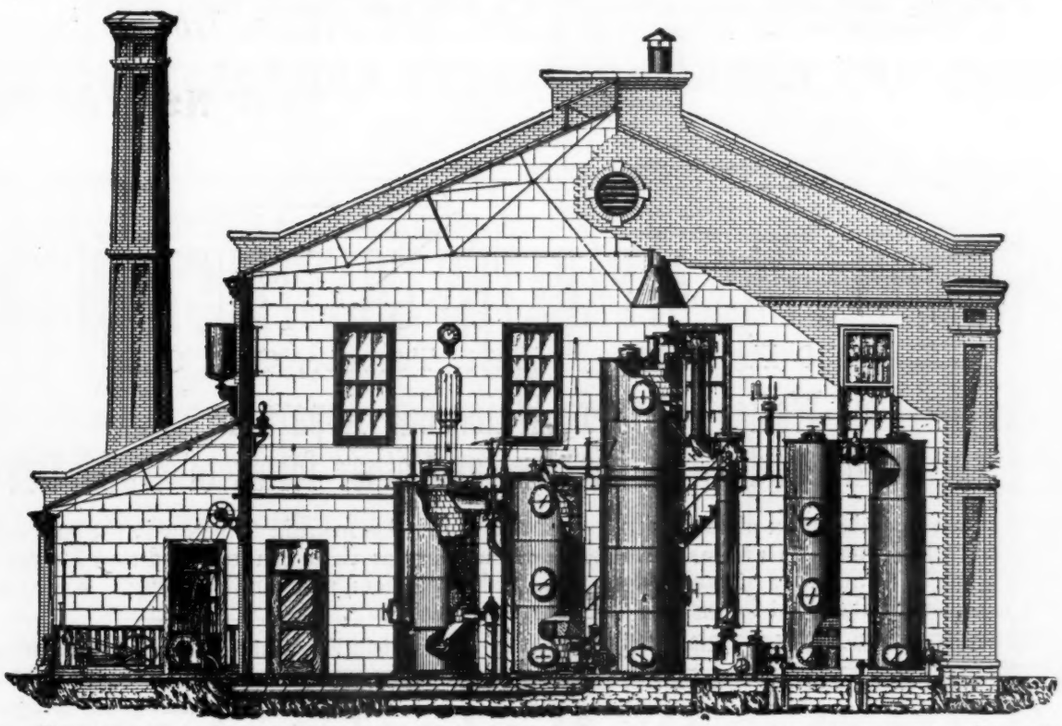
THE UNITED GAS IMPROVEMENT CO.,

DREXEL BUILDING, PHILA., PA.

Inquiries from any part of the United States should be addressed to the Philadelphia Office.

BUILDERS OF

THE STANDARD LOWE WATER GAS APPARATUS.



Standard "Double Superheater" Lowe Apparatus, designed for the use of Naphtha, Crude Oil, or "Distillates."

BUILDERS, LESSEES AND PURCHASERS OF GAS WORKS.

Water Gas Plants, either independent or auxiliary to Coal Gas Works, erected to meet any conditions. Apparatus designed to use any grade of Oil, and Anthracite Coal, or Gas House or Oven Coke.

PAMPHLETS, PLANS AND ESTIMATES FURNISHED UPON APPLICATION.

THE WESTERN GAS CONSTRUCTION CO.,

FORT WAYNE, IND.,

Engineers and Builders.

We have Installations of our

Improved LOWE WATER GAS Apparatus

At Akron, Canton and Salem, Ohio; Springfield, Ills.; Covington, Ky.; Lincoln, Neb.; Charlotte, Mich.; RICHMOND, VA.; Wilkes-Barre, Pa.; Middletown, N. Y.;

Of an Aggregate Capacity of **FOUR MILLION** per Diem.

ALSO, BUILDERS OF

Coal Gas Benches, Condensers, Scrubbers, Purifiers, Center Seals, Gasholders and Tanks, Coal and Oxide Conveyers and Elevators, Iron Roofs,

AND

GENERAL GAS WORKS APPARATUS AND CONSTRUCTION.

W. H. PEARSON, President. J. T. WESTCOTT, Gen'l Mang'r & Treas. (Formerly with The United Gas Improvement Co.) L. L. MERRIFIELD, Chief Engineer. (Formerly with the United Gas Improvement Co.)

The ECONOMICAL GAS APPARATUS CONSTRUCTION CO., Ltd.

Office, 269 Front Street, East, Toronto, Ont., Can.

Owners of the Merrifield-Westcott-Pearson Water Gas Apparatus, and Builders of the Lowe and other forms of Water Gas Plants.

Our system includes a combination of the best processes of Water Gas manufacture now in use, and an apparatus of novel construction, which enables us to make a better and cheaper gas than can be produced by any other process. Guarantees given as to quantity of fuel and oil used, make per diem, and candle power. We also make an apparatus which is especially designed for small Gas Companies.

CORRESPONDENCE SOLICITED. Plans and Estimates Furnished upon Application.

The "Little Giant" Water Gas Generator

IS THE MOST ECONOMICAL GENERATOR IN THE WORLD, BOTH IN COST AND OPERATION.

It takes but little room. It requires no change to be made in the height or depth of gas houses.

It is simpler and easier operated. It makes *more good gas from a given quantity of stock.* It makes good gas from *cheaper stock.* It makes gas of *any desired candle power* up to thirty without smoke. It makes a faultless gas from whatever gas-producing materials are cheapest in the locality where required, using hard coal or coke in connection with Lima crude or any other crude petroleum or its distillates, including *naphtha of any specific gravity.*

I build these Generators with any required capacity, from 3,000 cubic feet per hour upward. All the plants which I have built for the past four years can be seen in operation. Results are, in all cases, better than guaranteed.

In more than one half the gas works in the country the "Little Giant" will enable *one man* to easily make, in *five hours*, all the gas needed for the *twenty four hours.*

Everything is guaranteed, including durability and capacity of the Generator, the quality of the gas, and its cost.

Correspondence solicited.

A. M. SUTHERLAND, No. 136 Liberty Street, New York City.

NATIONAL GAS AND WATER CO.,

218 La Salle St., Chicago, Ill.

HENRY C. REW, Prest. C. D. HAUK, Vice-Prest. & Mang'r. N. A. McCLARY, Sec'y. IRWIN REW, Treas. E. E. MORRELL, Engineer

Builders and Operators of Gas Works.

WATER GAS APPARATUS A SPECIALTY.

SOLE OWNERS OF THE REW SOFT COAL CARBURETED WATER GAS APPARATUS.

Guaranteed Estimates of Cost of Gas in Holder Furnished upon Application.

CONNELLY IRON SPONGE AND GOVERNOR CO.,

(Successors to CONNELLY & CO.)

MANUFACTURERS OF GAS WORKS SPECIALTIES.

"IRON SPONGE." Saves money, saves labor, and is the most efficient purifying material ever offered as a substitute for lime. We guarantee a large saving, both in cost of material and labor.

AUTOMATIC GOVERNOR. OVER FOUR HUNDRED NOW IN USE! NO WORKS COMPLETE WITHOUT IT! WILL PAY FOR ITSELF WITHIN A YEAR! ITS SERVICE SECURES PERFECT DISTRIBUTION; REDUCES LEAKAGE TO MINIMUM, and BENEFITS THE COMPANY and CONSUMER ALIKE! IT IS THE ONLY RECOGNIZED AUTOMATIC GOVERNOR IN THE WORLD!

STEAM JET EXHAUSTER. Designed particularly for small works. Combines Exhaust Tube, Steam Governor, Gas Compensator and Bye-Pass Valves in the most compact form possible. Occupies but little space; uses very little steam; saves formation of carbon in retorts; increases yield 10 to 15 per cent. No works too small to use them profitably.

Prices given on all our specialties, delivered at any point in the United States. Correspondence solicited.

CONNELLY IRON SPONGE AND GOVERNOR CO., No. 365 Canal St., New York.

WILBRAHAM BAKER BLOWER COMPANY,

Successors to WILBRAHAM BROS.,

Philadelphia, Pa.,

SOLE MAKERS OF

THE HUNTOON GAS GOVERNOR,

The Best Governor in the Market for Rotary or Steam Jet Exhausters.

Wilbraham Gas Exhausters,

BAKER ROTARY PRESSURE BLOWERS,

And Rotary Piston Pumps.

Catalogues and Prices on Application.

IRON MASS

For Gas Purification.

Acts immediately, and more efficiently than any other purifying agent now in use.

Greenpoint Chemical Works.

JOHN SCHRIEVER, Manager.

Greenpoint Ave. & Newtown Creek, Brooklyn N.Y.

DOUGLAS' FERRIC OXIDE

For Gas Purification

Is a superior natural Hydrated Oxide of Iron. Will give a higher purification per bushel than any other material. We ship the pure Oxide of Iron, containing no sawdust, thus effecting a saving in freight, leaving the consumer to furnish the diluent at a nominal cost. It is now used by the largest gas companies in the West.

Full information, with references to many users, and prices delivered in any locality, furnished on application to

H.W. Douglas (Supt. Ann Arbor Gas Company) **Ann Arbor, Mich.**

JAMES D. PERKINS. **PERKINS & CO.,** F. SEAVERNS.

228 & 229 Produce Exchange, New York City.

TIDEWATER SALES AGENTS FOR THE FOLLOWING

Standard Gas Coals and Cannel:

Ocean Mine Youghiogheny Gas Coal,

Clinch Valley Gas Coal, and the

Old Kentucky Shale, for Enriching Purposes.

Cargo Shipments from New York, Philadelphia, Baltimore and Norfolk.

Single carloads or more delivered at any required point in the United States or Canada.

SCIENTIFIC BOOKS.

KING'S TREATISE ON THE MANUFACTURE OF COAL GAS. Three vols.; $10 per vol.

GAS MANUFACTURE, by WILLIAM RICHARDS. 4to., with numerous Engravings and Plates, in Cloth binding. $12.

TECHNICAL GAS ANALYSIS. $3.

GAS CONSUMER'S GUIDE. $1.

GAS CONSUMER'S HANDBOOK, by WILLIAM RICHARDS, C.E.; 18mo., Sewed. 20 cents.

A PRACTICAL TREATISE ON GAS AND VENTILATION with Special Relation to Illuminating, Heating, and Cooking by Gas, by E. E. PERKINS. $1.25.

CHEMISTRY OF ILLUMINATING GAS, by NORTON H. HUMPHRYS. $2.40.

PRACTICAL TREATISE ON HEAT, by THOMAS BOX. Second edition. $5.

PRACTICAL PHOTOMETRY; A GUIDE TO THE STUDY OF THE MEASUREMENT OF LIGHT. By W. J. DIBDIN. $3.

STRAINS IN IRONWORK, by H. ADAMS. With plates. $1.75

GAS WORKS—THEIR ARRANGEMENT, CONSTRUCTION, PLANT, AND MACHINERY. $5.

COAL; ITS HISTORY AND USE. by PROF. THORPE. $3.50.

THE GAS WORKS OF LONDON, by COLBURN. 60 cents.

HEAT A MODE OF MOTION, by JOHN TYNDALL. $2.50.

THE MANAGEMENT OF SMALL GAS WORKS, by C. J. R. HUMPHREYS. $1.

MANUAL FOR GAS ENGINEERING STUDENTS, by D. LEE, 40 cents.

THEORY OF HEAT, by J. CLERK-MAXWELL. $1.25.

AMMONIA AND AMMONIUM COMPOUNDS, by DR. R. ARNOLD. $2.

THE DOMESTIC USES OF COAL GAS, AS APPLIED TO LIGHTING, by W. SUGG. $1.40.

DIGEST OF GAS LAW. $5.

DISTLLATION OF COAL TAR AND AMMONIACAL LIQUOR, by GEO. LUNGE. New Edition. $12.50.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS, by D. A. GRAHAM 8vo., Cloth. $3.

THE AMERICAN GAS ENGINEER AND SUPERINTENDENT'S HANDBOOK, by WM. MOONEY. $3.

A TEXT BOOK OF INORGANIC CHEMISTRY, by Professor VICTOR VON RICHTER. $2.

ILLUMINATING AND HEATING GAS, by W. BURNS. $1.50.

HANDBOOK FOR MECHANICAL ENGINEERS, by HENRY ADAMS. $2.50.

FUEL AND ITS APPLICATIONS. $7.50.

NEWBIGGING'S HANDBOOK FOR GAS ENGINEERS AND MANAGERS, by THOS. NEWBIGGING. Fifth edition. $6.

A TREATISE ON MASONRY CONSTRUCTION. BARKER. $5

ELECTRICITY.

THE ELEMENTS OF ELECTRIC LIGHTING, Including Electric Generation, Measurement, Storage, and Distribution, by PHILIP ATKINSON. $1.50.

ELEMENTARY ELECTRICITY, by PROF. F. JENKIN. 40 cts

ELECTRIC TRANSMISSION OF ENERGY, by G. KNAPP. $3

ARC AND GLOW LAMPS, by J. MAIER. Illustrated. $3.

ELECTRICIAN'S POCKET-BOOK, by MONROE and JAMIESON. $2.50.

MAGNETISM AND ELECTRICITY, by J. OVEREND. 40 cents.

ACCUMULATORS, by SIR D. SALOMONS. $1.20.

DYNAMO BUILDING, by F. W. WALKER. 80 cents.

ELECTRICAL TABLES AND FORMULÆ, by L. CLARK R. SABINE. $5.

ELECTRIC LIGHTING FROM CENTRAL STATIONS, by G FORBES. Paper. 40 cents.

ELECTRIC LIGHT PRECAUTIONS, by K. HEDGES. Illustrated. $1.

DOMESTIC ELECTRICITY FOR AMATEURS, by E. HOSPITALIER. $3.

The above will be forwarded by express, upon receipt of price. If sent by mail, postage must be added to above prices. We take especial pains in securing and forwarding any other Works that may be desired, upon receipt of order. All remittances should be made by check, draft, or post office money order.

A. M. CALLENDER & CO., 32 Pine Street, New York

GAS ENRICHERS. GAS COALS. GAS COALS.

The Despard Gas Coal Co.,

MINERS AND SHIPPERS OF

DESPARD GAS COAL,

AND MANUFACTURERS OF

COKE.

MINES, Clarksburg, Harrison Co., W. Va.
WHARVES, Locust Point, Baltimore, Md.
OFFICE, 44 South Street, Baltimore, Md

ROUSSEL & HICKS, 71 Broadway, N. Y. } AGENTS. } BANGS & HORTON, 60 Congress St., Boston

ENRICH YOUR GAS

WITH OUR

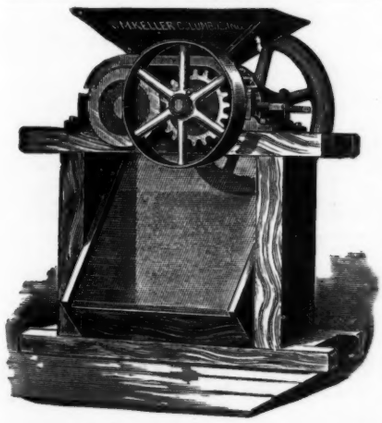
"BEAR CREEK" CANNEL

Containing

14,630 Cu. Ft. of 41-Candle Gas and 995 lbs. of good Coke per ton of 2,240 lbs.

Log Mountain Coal, Coke & Timber Co.,

PINEVILLE, KY.



Keller's Adjustable Coke Crusher

SIMPLE, STRONG, AND DURABLE.

C. M. Keller, Sec. & Supt. Gas Lt. & Coke Co. Columbus, Ind.
Correspondence Solicited.

THE PENN GAS COAL CO.

OFFER THEIR

Coal, Carefully Screened & Prepared for Gas Purposes

Their Property is located in the Youghiogheny Coal Basin, near Irwin and Penn Stations on the Pennsylvania Railroad, and on the Youghiogheny River.

Principal Office:

209 SOUTH THIRD STREET, PHILA., PA.

Points of Shipment:

Pennsylvania Railroad Piers; Greenwich Wharves, Delaware River; Pier No. 1 (Lower Side), South Amboy, N. J.

EDMUND H. McCULLOUGH, Prest. CHAS. F. GODSHALL, Treas. H. C. ADAMS, Sec.

THE WESTMORELAND COAL CO.

Chartered 1854.

Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Pa.

POINTS OF SHIPMENT:

PHILADELPHIA, BALTIMORE, SOUTH AMBOY, N. J.,
WATKINS (SENACA LAKE), N. Y.

Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas-giving qualities, and in freedom from sulphur and other impurities.

Principal Office, 224 South 3d St., Phila., Pa.

THE SUN OIL CO.,

OHIO CRUDE OIL,

38 to 41 Degrees Gravity.

Toledo, O., and Pittsburgh, Pa.

Standard Oil Company,

GAS NAPTHA DEPARTMENT.

GAS NAPTHA.

GAS OIL.

Correspondence Solicited

26 Broadway, New York City.

RETORTS AND FIRE BRICK. RETORTS AND FIRE BRICK. RETORTS AND FIRE BRICK.

J. H. GAUTIER & COMPANY
CORNER OF
GREENE AND ESSEX STREETS,
JERSEY CITY, N. J.
MANUFACTURERS OF
Clay Gas Retorts,
Gas House Tiles,
Fire Bricks, Etc. Etc.
Ground Clay, Fire Brick and Fire Sand in Barrels,
H GAUTIER, Prest. CHAS. E. GAUTIER, Sec. & Treas.
HA . E. GREGORY, V.-Prest. DAVID R. DALY Gen'l Mang'r.

Brooklyn Fire Brick Works,
MANUFACTURERS OF
CLAY RETORTS, FIRE BRICK,
Gas House and other Tile.
Office, 88 Van Dyke St., Brooklyn, N. Y.

LACLEDE FIRE BRICK MFG. CO.,
MANUFACTURERS OF
Fire Brick, Gas Retorts,
AND
ST. LOUIS STANDARD SEWER PIPE.
Blast Furnace and Cupola Linings, every description of Fire Clay Material, Fire Clay Flue Linings, Chimney Tops Dry Milled and Crude Fire Clays, etc.
OFFICE AND DEPOT
901, 903, and 905 Pine Street,
ST. LOUIS, MO.

ESTABLISHED IN 1845.
B. KREISCHER & SONS,
OFFICE FOOT OF HOUSTON ST., E.R., N.Y.
Gas Retorts,
TILES, FIRE BRICK.
AND EVERYTHING IN THE FIRE CLAY LINE.

MANHATTAN
FIRE BRICK & ENAMELLED CLAY
RETORT WORKS
ADAM WEBER.
CLAY GAS RETORTS
AND RETORT SETTINGS
FIRE BRICKS, TILES, ETC.,
Office and Works, 15th Street and Avenue C., N. Y

Works,
LOCKPORT STATION, PA.
—ESTABLISHED 1864.—
JAMES GARDNER, JR.,
Conestoga Bldg., Wood & Water Sts.
PITTSBURGH, PA, P. O. Box 372.
Successor to WILLIAM GARDNER & SON.
Fire Clay Goods for Gas Works.
SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.

HENRY MAURER & SON,
(ESTABLISHED 1856.)
EXCELSIOR FIRE BRICK & CLAY
RETORT WORKS
WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y
Clay Gas Retorts,
BENCH SETTINGS,
Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT.
A cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.
PRICE LIST.
In Casks, 600 to 800 lbs., f.o.b. N. Y., at 5 cents per pound.
In Kegs, 100 to 200 lbs., " " at 6 " "
In Kegs less than 100 lbs., " " at 7 " "
C. L. GEROULD & CO.,
5 & 7 Skillman St., Brooklyn, N. Y.
Western Agent, H. T. GEROULD, Decatur, Ills.

Parker-Russell Mining and Mfg. Co.,
CITY OFFICE,
Mermod-Jaccard Bldg., Rooms 307 & 308,
Broadway & Locust St., St. Louis. Mo.
PROPRIETORS OF THE
OAKHILL GAS RETORT & FIRE BRICK W'KS
Our immense establishment is now employed almost entirely in the manufacture of
Materials for Gas Companies
We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We have the *exclusive Agency for the West* of the celebrated
Kloenne-Bredel Full Depth and Semi-Recuperator Benches,
And also furnish and build
Our Own Styles Semi-Recuperator Furnaces for the use of Coal or Coke as fuel.

THOS. SMITH, Prest. AUGUST LAMBLA, Vice-Prest. & Supt.
BALTIMORE
RETORT & FIRE BRICK CO.
MANUFACTORY AT
LOCUST POINT BALTIMORE MD.
Clay Retorts, Blocks & Tiles
FIRE BRICK, FIRE CLAY,
AND FIRE CEMENT.
Red and Buff Ornamental Tiles and Chimney Tops. Drain and Sewer Pipe (from 2 to 30 inches). Baker Oven Tiles 12x12x2 and 10x10x2.
WALDO BROS., 88 WATER ST., BOSTON, MASS
Sole Agents the New England States.

King's Treatise on Coal Gas.
In Three Volumes. Price per Vol., $10.
Sold either by Volume or in Sets.
Standard text-book for the Engineers and Managers of Gas Works, and for all who are concerned or take an interest in the manufacture and distribution of Coal Gas, and in the utilization of the Secondary Products resulting therefrom; treating also of the Gas Engine and of Gas Cooking and Heating Appliances.
A. M. CALLENDER & CO., 32 Pine Street, N. Y. City.

FRED. BREDEL, C. E.,

PROP'R OF KLOENNE AND BREDEL PATENTS.

Recuperative Furnaces, Purifying Machines,

* Gas Apparatus. *

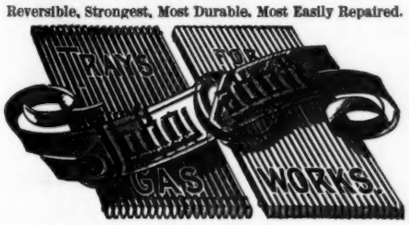
Main Office, 118 Farwell Avenue, Milwaukee, Wis.

New York Office, 22 Beaver Street.

Special Trays for Iron Sponge or Oxide of Iron.

CHURCH'S TRAYS a Specialty.

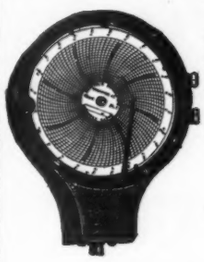
Reversible, Strongest, Most Durable. Most Easily Repaired.



506-310 Eleventh Avenue, New York.

We also make the Cheapest and Strongest
REVERSIBLE BOLTED TRAYS IN THE MARKET
Send for Circulars

BRISTOL'S RECORDING **PRESSURE GAUGE**



For Continuous Records of

Street Gas Pressure.

Simple in Construction,
Accurate in Operation,
Low in Price,
Fully Guaranteed.

Send for Circulars.

THE BRISTOL CO.
Waterbury, Conn.

Received Medal at World's Columbian Exposition.

E. G. LOVE, Ph.D.,

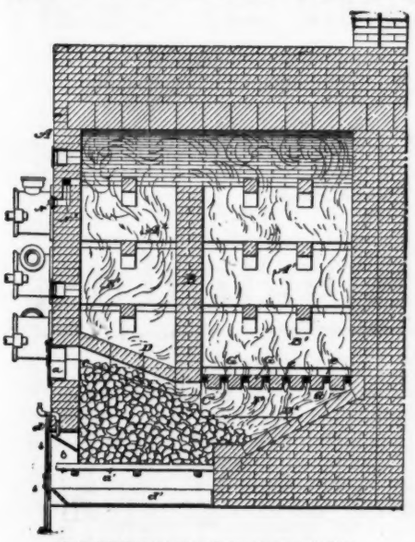
Analytical and Consulting Chemist.

Analyses of Coals, Purifying Materials, Gas, Gas Liquor, Water, and all Technical Products. Photometric and Calorimetric Determinations.

122 Bowery, New York City.

FLEMMING'S

Generator-Gas Furnace



Materials furnished and Benches erected by

J. H. GAUTIER & CO., - Jersey City, N. J.

Address as above, or D. D. FLEMMING, Jersey City, N. J.

AMERICAN GAS LIGHT JOURNAL.

$3.00 per Annum.

A. M. CALLENDER & CO.
32 Pine Street, N. Y.

The Miner Street Lamps.

Jacob G. Miner,

No. 823 Eagle Ave., New York, N. Y.

Bartlett Street Lamp Mfg. Co.

MANUFACTURERS OF

Globe Lamps,

FOR

Streets, Parks, Public Buildings, Railroad Stations, etc.

LAMP POSTS

A Specialty.

Office and Salesroom,

40 & 42 COLLEGE PLACE, - - N. Y. CITY

Gas Companies and others intending to erect Lamp and Posts will do well to communicate with us.

Parson's Steam Blower,

FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER.

FOR UTILIZING COAL TAR AS FUEL.

PARSON'S AIR JET TUBE CLEANER,

FOR CLEANING BOILER TUBES.

These devices are all first-class. They will be sent to any responsible party *for trial.* No sa unless satisfactory. Manufactured by the WATERTOWN STEAM BLOWER COMPANY.

H. E. PARSON, Supt., No. 54 Pine St., N. Y.

DAVIS & FARNUM MFG. CO.

WALTHAM, MASS.

PRINCIPAL OFFICE AND WORKS, WALTHAM, MASS. BOSTON OFFICE, Room 18, Vulcan Building, 8 Oliver Street.

Single, Double and Triple-Lift

GASHOLDERS

of any Capacity.

Tubular, Pipe and Sinuous Friction

CONDENSERS

of all Sizes.

STEEL TANKS for GASHOLDERS. IRON ROOF FRAMES and FLOORS.

Purifying Boxes, Center Seal or Valve Connections, Bench Work.

Reversible Lime Trays.

SELF-SEALING AND PRESSED STEEL MOUTHPIECE LIDS.

Coke Barrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Plant.

— ALSO —

GAS AND WATER PIPE, FLANGED PIPE,

Sugar House Work, and Special Castings of all Description.

Do You Contemplate Putting in any New Apparatus or Remodeling your Gas Plant this Season?

If so, write us for an estimate before placing your orders. We are Manufacturers and Builders of the

LATEST STYLE

Coal, Water and Oil Gas Apparatus,

SINGLE-LIFT and TELESCOPIC GASHOLDERS,

With or without Iron or Steel Tanks. We also make

Double Gate Valves, Street Special Castings, and Castings of all Descriptions for Gas Works.

We can guarantee all orders to be executed promptly, and in every respect satisfactory.

KERR MURRAY MANUFACTURING CO.,

Fort Wayne, Ind.

Plans and Specifications furnished on application.

BARTLETT, HAYWARD & CO.

Baltimore. Md.

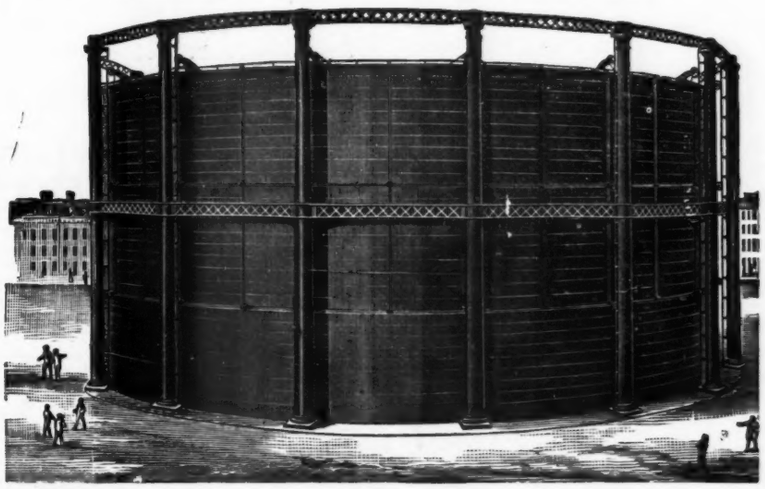
Triple Double, & Single-Lift
GASHOLDERS.

Iron Holder Tanks.

ROOF FRAMES.

Girders.

BEAMS.



PURIFIERS.

CONDENSERS.

Scrubbers.

BENCH CASTINGS.

OIL STORAGE TANKS.

Boilers.

The Wilkinson Water Gas Process.

THIRTY-CANDLE, NON-CONDENSABLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.

Munich Regenerative Furnace, System Drs. Schilling & Bunte.

MILL'S REVERSIBLE LIME TRAYS.

Gas Works Designed and Constructed.

THE
LUDLOW VALVE MFG. CO.,

MANUFACTURERS OF

VALVES,

Double and Single Gate, ¾ in. to 72 in., outside and inside Screws. Indicator, etc., for Gas, Water, Steam, Oil and Ammonia.

SEND FOR CIRCULAR.

SEND FOR CIRCULAR.

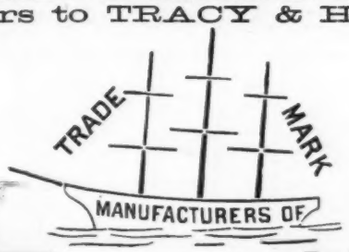
ALSO,

Hydraulic Main Dip Regulators, Check Valves, Foot Valves, Yard Wash and Fire Hydrants.

OFFICE AND WORKS:
938 to 954 River St., & 67 to 83 Vail Av.
TROY, N. Y.

NEW YORK MARINE PAINT CO.

Successors to TRACY & HADDEN.



PAINT PECULIARLY ADAPTED TO STAND ON Holders

And all Ironwork about Gas Works.

POUGHKEEPSIE, N. Y.

GASHOLDER PAINT.

Use Only
THE GOVERNMENT WATERPROOF PAINT.

Proof against Ammonia, and Absolutely Waterproof. Send for Prices and Particulars.

THE GOVERNMENT WATERPROOF PAINT CO. 104 High Street. Boston. Mass.

CHAPMAN VALVE MANUFACTURING CO.,

MANUFACTURERS OF

Valves and Gates for Gas, Ammonia, Water, Etc.

Also, Gate Fire Hydrants with and without Independent Nozzle Valve. All Work Guaranteed.

Works & Gen'l Office, Indian Orchard, Mass, Treasurer's Office, 72 Kilby & 112 Milk Sts., Boston Mass.
Chicago Office, 24 West Lake St. New York Office, 28 Platt St.
St. Louis Office, L. M. Rumsey Mfg. Co., 810 North Second St.

Foundries and Works: { Millville, N. J. / Florence, " / Camden, "

R. D. WOOD & CO.

ENGINEERS, IRON FOUNDERS, MACHINISTS

400 Chestnut Street, PHILADELPHIA, PA.

MANUFACTURERS OF

CAST IRON PIPE

SOLE MAKERS OF

THE MITCHELL SCRUBBER

(PATENTED)

PURIFIERS, CONDENSERS, SCRUBBERS.

THE HOPPER AUTOMATIC GAS GOVERNOR.

BENCH WORK. PLATE GIRDERS.

IRON FLOORS AND ROOFS.

BUILDERS OF

GAS HOLDERS

Single, Double and Tripie Lifts, with or without Wrought Iron or Steel Tanks.

PEASE'S PATENT WIRE ROPE GUIDING FOR GAS HOLDERS.

CUTLER'S PATENT FREEZING PREVENTER FOR GAS HOLDER CUPS.

THE TAYLOR REVOLVING BOTTOM GAS PRODUCER,

HEAVY LOAM CASTINGS, DUNHAM SPECIALS, HYDRAULIC WORK

LAMP POSTS, VALVES, ETC.

ISBELL-PORTER CO.,

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

FOUNDERS AND MACHINISTS.

MANUFACTURERS OF

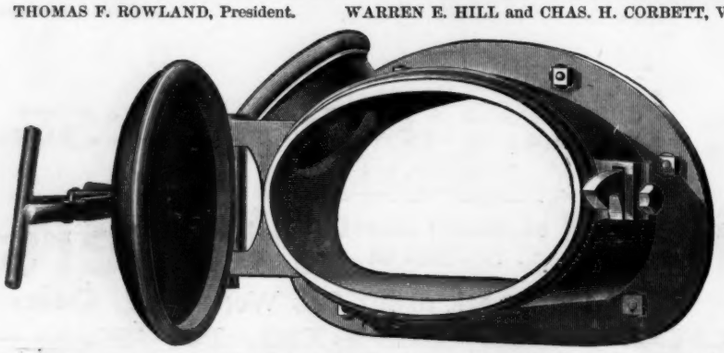
All Ironwork and Machinery Required in a Gas Plant.

Estimates, Drawings and Specifications furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

245 Broadway, New York City. —OFFICES— Bridge & Ogden Sts., Newark, N. J.

The Continental Iron Works

THOMAS F. ROWLAND, President. WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents. THOMAS F. ROWLAND, JR., Secretary & Treasurer.



BROOKLYN, N. Y.

TAKE EAST TENTH OR TWENTY-THIRD STREET FERRIES FROM N. Y. TO GREENPOINT.

BUILDERS OF

Gas Holders.

Single and Multiple Section Gas Holders a Specialty.

Wrought Iron Gasholder Tanks.

BENCH CASTINGS, RETORT LIDS.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, Etc.

SELF-SEALING RETORT MOUTHPIECES AND LIDS,

For Round, Oval, or "D" Retorts.

Partial List of Gas Companies using our Self-Sealing Mouthpieces:

Bridgeport, Conn.	Northern, N. Y. City.	Westfield, Mass.	East Boston, Mass.	Stamford, Conn.
Charleston, S. C.	Painsville, Ohio.	Williamsburgh, N. Y.	Holyoke, Mass.	Taunton, Mass.
Central, N. Y. City.	Salem, Mass.	Buffalo Mutual, N. Y.	Palatka, Fla.	Worcester, Mass.
Gainsville, Fla.	Springfield, Mass.	Clarksville, Tenn.	Providence, R. I.	And many others.

THE MANAGEMENT OF SMALL GAS WORKS.

By C. J. R. HUMPHREYS.

Price $1.

A. M. CALLENDER & CO., No. 32 Pine Street, New York.

GAS WORKS APPARATUS AND CONSTRUCTION. GAS WORKS APPARATUS AND CONSTRUCTION.

JAMES R. FLOYD & SONS,
(SUCCESSORS TO HERRING & FLOYD)
Oregon Iron Works,
W. 20th & 21st Sts., bet. 10th & 11th Aves.
NEW YORK CITY.
ENGINEERS AND CONTRACTORS FOR THE
Construction of Gas Works.
MANUFACTURERS OF
All Kinds of Castings and General Ironwork
FOR
GAS APPARATUS.
BENCH CASTINGS, REGENERATIVE AND HALF REGENERATIVE FURNACE CASTINGS.
CONDENSERS.
TOWER SCRUBBERS.
MECHANICAL SCRUBBERS.
PURIFIERS.
MALLEABLE IRON RETORT LIDS.
SELF-SEALING RETORT LIDS.
HYDRAULIC HOIST PURIFIER CARRIAGE.
CROSSES, TEES, BENDS, ANGLES, REDUCERS, S-BENDS, SECTIONAL SLEEVES, PLUGS, CAPS, STREET DRIPS, ETC., ALWAYS ON HAND.
Seller's Cement.
WOOD'S GAS SCRUBBING AND ENRICHING APPARATUS,
In use at Syracuse, N. Y.; Elizabeth, N. J.; Boston, Mass.; Watertown, N. Y.; Cortland, N. Y.; Jamaica Plain, Mass.; Northern Liberties Gas Co., Phila.
SOLE MANUFACTURERS OF THE
OGDEN QUICK-MOVING VALVE.
Plans, Specifications and Estimates furnished for Construction of New or Alteration of Old Works.

H. RANSHAW, Prest. & Mangr. WM. STACEY, Vice-Prest. T. H. BIRCH, Asst. Mangr. R. J. TARVIN, Sec. & Treas.
STACEY MFG. CO.,
MANUFACTURERS OF
Single and Telescopic Gasholders,
IRON ROOFS, BRIDGES, LAMP POSTS,
Water and Oil Tanks, Coal Elevator Cars,
COKE CRUSHERS, BENCH CASTINGS,
And all kinds of Wrought and Cast Iron Work used in the erection of Coal and Oil Gas Works. Rolling Mill Machinery and Heavy Castings a Specialty.
Foundry: 33, 35, 37 & 39 Mill Street. Wrought Iron Works: 16, 18, 20, 22, 24 & 26 Ramsey Street.
Cincinnati, Ohio.

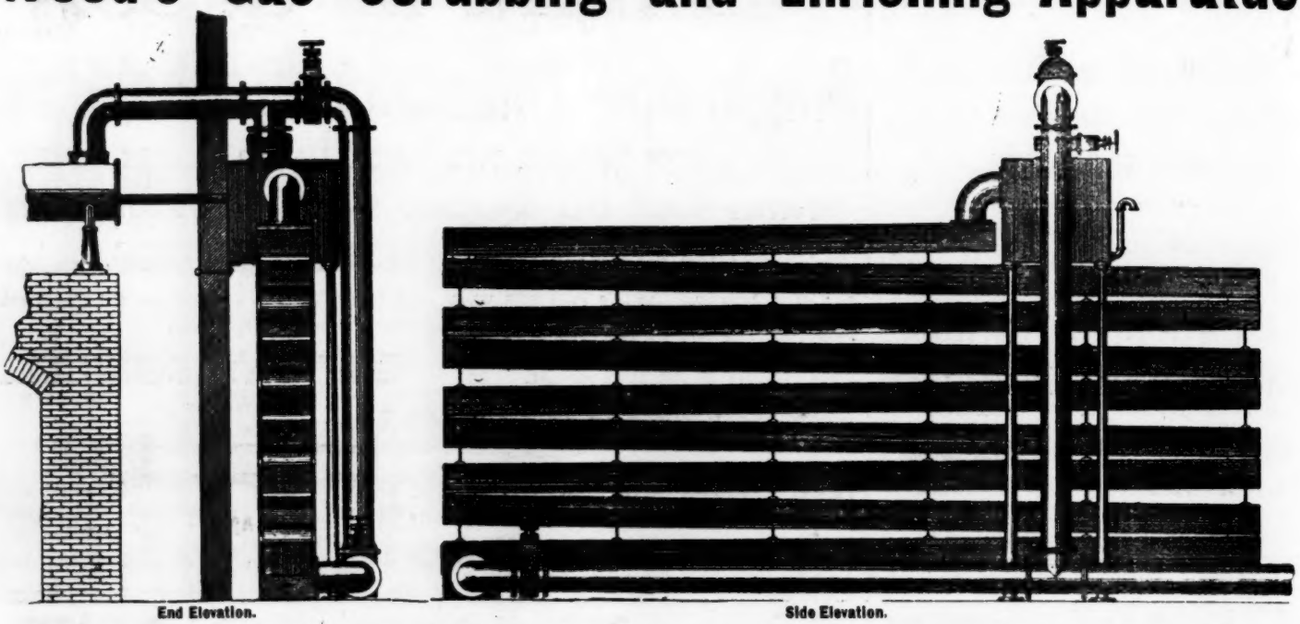
1842. DEILY & FOWLER, 1894
Laurel Iron Works.
Address, No. 39 Laurel Street, Philadelphia, Pa.
BUILDERS OF
GASHOLDERS,
Single and Telescopic.
Holders Built 1886 to 1892, Inclusive

Galveston, Texas. (3d.)	Malden, Mass.	Lancaster, Pa. (3d	Oakland, Cal.	So. Bethlehem, Pa. (2d)
Fort Plain, N. Y.	Paducah, Ky.	Tacony, Pa. (two)	Central Gas Lt. Co., New York City (2d)	"Vassar College," N. Y
Brunswick, Ga.	Norwich, Conn.	Mount Vernon, N. Y.		So. Chester, Pa.
Port Chester, N. Y.	Seattle, W. T.	Binghamton, N. Y.	Tacoma, Wash.	Cumberland, Md.
New Rochelle, N. Y.	San Diego, Cal.	Concord, N. H.	Knoxville, Tenn.	Auburn, N. Y.
Salem, N. J. (3d)	Westerly, R. I.	Dover, Del. (3d)	Pottstown, Pa.	DesMoines, Ia.
Omaha, Neb. (3d)	Northern Gas Lt. Co., of New York, N. Y.	Calais, Me.	Victoria, B. C.	Brooklyn, N. Y.
Lynn, Mass. (3d)		New London, Conn. (3d)	Vancouver, B. C.	Washington, D. C. (2d
Little Rock, Ark.	Willimantic, Conn	West Chester, N. Y.	Charlottesville, Va.	Wilkes-Barre, Pa.
Irvington, N. Y.	Montclair, N. J.	Bay Shore, L. I.	So. Framingham, Mass.	Bridgeport, Conn. (2d)
South Boston, Mass.	Attleboro, Mass.	Washington, D. C.	Woonsocket, R. I.	Sing Sing, N. Y.
Rye, N. Y. (2)	Santa Cruz, Cal.	Newport, R. I. (2d)	Simcoe, Can.	Exeter, N. H.
Staten Island, N. Y. (2d)	Erie, Pa. (2d)	Morristown, N. J.	Pittsfield, Mass. (2d)	Wilkes-Barre, Pa., ons
Woodstock, Ont.	West Chester, Pa. (2d	Lebanon, Pa.	Chattanooga, Tenn. (2d)	Lynn, Mass. (2d) [Gas Co

ILLUMINATING GAS! FUEL GAS!
The Loomis Process.
Now in successful operation at Works of John Russell Cutlery Co., Turner's Falls, Mass., and Henry Disston's Sons' Saw Works, Tacony, Pa.
The Cheapest Gas Generating System in the World.
Plans and Estimates Furnished.
BURDETT LOOMIS, - - Hartford, Conn.

WM. HENRY WHITE,
No. 32 Pine Street, - - - New York City.
ENGINEER AND CONTRACTOR FOR THE
ERECTION AND EXTENSION OF
GAS, WATER, AND ELECTRIC LIGHT WORKS.
Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited
Plans and Estimates Furnished.

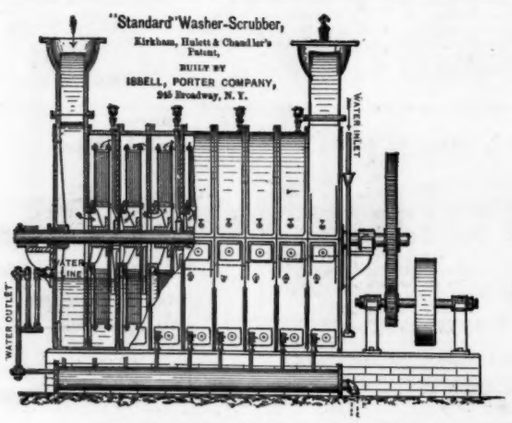
Wood's Gas Scrubbing and Enriching Apparatus.



End Elevation. Side Elevation.

The cheapest, simplest, and most effective apparatus for removing Tar and Ammonia, and enriching Gas, ever brought to the attention of Gas Manufacturers. With ordinary condensers and scrubbers the condensable illuminants flow off to the tar wells and liquor tanks and are lost, but with Wood's Apparatus these illuminants are saved and retained in the gas, thus increasing its illuminating power and making a great saving in the cost of enriching material. Where set up next after the Hydraulic main, this Scrubber produces an 8-oz. Ammoniacal Liquor.

JAMES R. FLOYD & SONS, - - Nos. 531 to 543 West 20th Street, N. Y. City.



Estimates Furnished on Application.

"STANDARD" WASHER-SCRUBBER

The only apparatus that will remove ALL the ammonia and one-third of the Carbonic Acid and Sulphureted Hydrogen from Coal Gas.

86

of these machines, capable of dealing with 75,082,000 cubic feet of gas daily, have been erected in the United States, and 456 in Great Britain. The "Standard" will save 25 per cent. to 35 per cent. on the investment through the sale of ammonia.

GEORGE SHEPARD PAGE'S SONS,

No. 69 Wall Street, - - - New York City.

FIELD'S ANALYSIS

For the Year 1892.

An Analysis of the Accounts of the Principal Gas Undertakings in England, Scotland, and Ireland. Being the Twenty-third Year of Publication. Compiled and Arranged by

JOHN W. FIELD, Accountant to the Gas Lt. and Coke Co., London.

Price, $5. For Sale by

A. M. CALLENDER & CO., - No. 32 Pine Street, N. Y. City.

GAS AND WATER PIPES. GAS METERS.

THE OHIO PIPE COMPANY,

MANUFACTURERS OF

Cast Iron Gas & Water Pipe,

BRANCH AND SPECIAL CASTINGS.

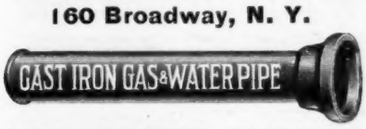
Gas-House Bench Castings, Hydraulics, Lamp Posts, Flange Pipe and Specials, Architectural Castings, Building Columns, Joists, Cellar Grates, Sash Weights, etc.

GENERAL FOUNDERS AND MACHINISTS

Columbus, Ohio.

JOHN FOX,

160 Broadway, N. Y.



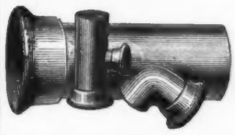
SPECIAL CASTINGS, FLANGE PIPE, FIRE HYDRANTS, STOP VALVES, LAMP POSTS, Etc., Etc.

General Foundry and Machine Work.

WARREN FOUNDRY AND MACHINE CO.,

Established 1856. Works at Phillipsburgh, N. J.

New York Office, 160 Broadway.



CAST IRON WATER AND GAS PIPE,

FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc

M. J. DRUMMOND,

SPECIAL CASTINGS AND LAMP POSTS.

Office, Corbin Building, 192 Broadway, N. Y.

GEORGE ORMROD, Mangr. & Treas., Emaus, Pa.
JOHN DONALDSON, Prest., Betz Bldg., Phila., Pa

EMAUS PIPE FOUNDRY.

DONALDSON IRON COMPANY. EMAUS, PA.

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

Also, FLANGE PIPE, LAMP POSTS, Etc.

THE ADDYSTON PIPE AND STEEL COMPANY,

CAST IRON.

PIPE.

CINCINNATI, OHIO.

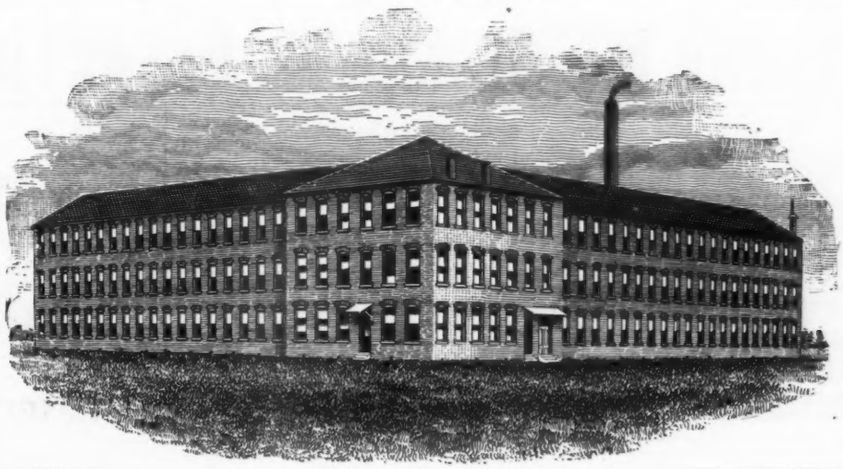
Purifiers, Condensers, Scrubbers & Center Valves

SPECIALS, FLANGE PIPE, AND LAMP POSTS.

C. N. PAYNE, Prest.

J. B. WALLACE, Supt.

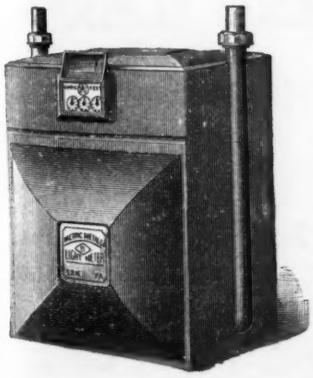
F. H. PAYNE, Sec. and Treas.



Factory and Office

ERIE, PA.

ESTIMATES FURNISHED ON APPLICATION.



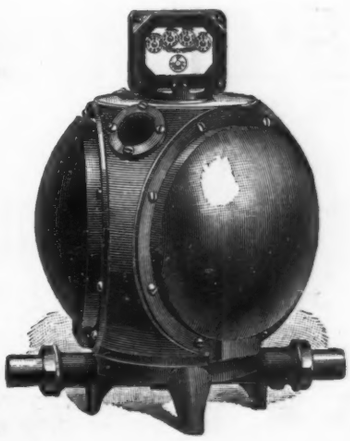
METRIC METAL CO.,

MANUFACTURERS OF

Dry Gas Meters

FOR ALL KINDS OF SERVICE.

Special Attention Paid to REPAIRING METERS OF ALL MAKES.



Agts., McELWAINE-RICHARDS CO., 62 & 64 W. Maryland St., Indianapolis, Ind.

JOHN J. GRIFFIN & CO.,

Nos. 1513, 1515, 1517 & 1519 Race Street, PHILADELPHIA.
No. 52 Dey Street, NEW YORK. No. 75 North Clinton Street, CHICAGO.

MANUFACTURERS OF

METERS FOR MEASURING GAS

IN ANY VOLUME.

Provers, Gauges, Registers, Etc., Etc.

EXPERIMENTAL APPARATUS FOR QUANTITATIVE AND QUALITATIVE ANALYSIS.

Careful and Prompt Attention paid to Repairing of all kinds of Meters and Apparatus.

Estimates Cheerfully Furnished.

Established 1849.

With the best facilities for manufacturing, is enabled to furnish reliable work and answer orders promptly.

NATHANIEL TUFTS,

153 Franklin St., Boston, Mass.

C. W. HINMAN, - - Manager.

MANUFACTURER OF

DRY GAS METERS.

Station Meters of any Capacity.

Test and Experimental Meters, Pressure Registers, Pressure Gauges.

METER PROVERS, PHOTOMETERS, STREET LANTERNS, ETC., ETC.

Apparatus for the Chemical Testing of Gas and Gas Liquor.

CHARLES E. DICKEY. JAMES B. SMALLWOOD. CHARLES H. DICKEY.

THE MARYLAND METER AND MANUFACTURING CO.

Established 1866.

BALTIMORE, North & Saratoga Sts. **CHICAGO, 122 & 124 Michigan St.**
NEW YORK, 838 Broadway. **SAN FRANCISCO, 221 Front St.**
BOSTON, 92 Water Street, Rooms 21 and 22.

CONSUMERS' & STATION METERS, PRESSURE GAUGES, Etc., Etc.

"Success" and "Perfect" Gas Stoves.

Established 1849.

HARRIS BROS. & CO.,

Twelfth and Brown Streets, Phila., Pa.

Agency, 67 & 69 S. Canal Street, Chicago.

Manufacturers of Wet and Dry Gas Meters,

STATION METERS, METER PROVERS,

EXPERIMENTAL METERS, SHOW OR GLAZED METERS,

Pressure and Vacuum Registers, Gauges, Photometers, Drip and Bell Pumps, Etc., Etc.

PROMPT ATTENTION GIVEN TO ALL ORDERS. METERS THOROUGHLY REPAIRED. ESTIMATES FURNISHED FOR STATION METERS OF ALL SIZES. CORRESPONDENCE SOLICITED.

GAS METERS. GAS METERS. GAS METERS.

WM. N. MILSTED, Prest. and Genl. Supt. WM. H. HOPPER, Vice-Prest. PAUL S. MERRIFIELD, Sec. and Treas.

THE AMERICAN METER CO.

Established 1834. Incorporated 1863.

WET AND DRY GAS METERS. PRESSURE REGISTERS. METER PROVERS.
STATION METERS. PRESSURE & VACUUM REGISTERS. PORTABLE TEST METERS.
EXHAUSTER GOVERNORS. PRESSURE & VACUUM GAUGES. EXPERIMENTAL METERS.
DRY CENTER VALVES. CRESSON GAS REGULATORS. AMMONIA TEST METERS.
GOVERNORS FOR GAS WORKS. MARSLAND WATER METERS. BAR & JET PHOTOMETERS.

Manufactories:
512 West 22d St., N. Y.
Arch & 22d Sts., Phila.

GAS STOVES.
SUGG'S "STANDARD" ARGAND BURNERS,
SUGG'S ILLUMINATING POWER METER,
Wet Meters, with Lizar's "Invariable Measuring" Drum.

Agencies:
380 Main Street, Cincinnati.
125 & 127 S. Clinton Street, Chicago.
810 North Second Street, St. Louis.
222 Sutter Street, San Francisco.

HELME & McILHENNY,

(Established 1848.)

GAS METER MANUFACTURERS,

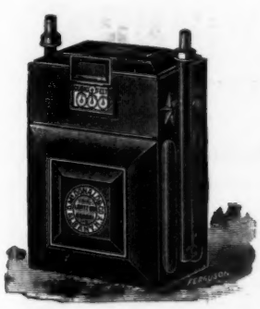
Nos. 1339 to 1349 Cherry Street, Philadelphia, Pa.,

WET AND DRY GAS METERS, STATION METERS, EXPERIMENTAL METERS, METER PROVERS,

Center Seals, Pressure Registers, Governors, Indicators, Photometers, and all other kinds of Apparatus for use in Gas Works

FOULIS' PATENT STATION AND DISTRICT GOVERNORS.

REPAIRING DEPARTMENT.—We employ a special force of skilled workmen repairing meters of **all makers.**



D. McDONALD & CO.,

Established 1854.

154 West 27th Street, NEW YORK CITY. | 51, 53 & 55 Lancaster St., ALBANY, N. Y. | 34 & 36 W. Monroe St., CHICAGO, ILL.

MANUFACTURERS OF

Wet and Dry Gas Meters

STATION METERS, EXPERIMENTAL METERS, METER PROVERS, PRESSURE & VACUUM REGISTERS & PRESSURE GAUGES.

Meters of all makers Thoroughly Repaired.

A CONVENIENT

BINDER for the JOURNAL.

STRONG.
DURABLE.
LIGHT.
SIMPLE
CHEAP.
HANDSOME.
Price, $1.

A.M. Callender & Co.,
32 Pine st.,
N. Y. City

The American Gas Engineer and Superintendent's Handbook.

By WM. MOONEY.

850 Pages, Full Gilt Morocco. Price. $8.00.

A. M. CALLENDER & CO., 32 Pine St., N. Y.

W. WALLACE GOODWIN, Prest. CALEB G. RIDGWAY, Vice-Prest. & Treas. CHARLES PAIST, Sec. H. B. GOODWIN, Supt. & Gen'l Mangr.

THE GOODWIN METER CO.,

1012, 1014 & 1016 Filbert Street, Philadelphia, Pa.

Agent, GEORGE B. EDWARDS, 113 Chambers Street, N. Y. City.

SOLE MANUFACTURERS OF THE

"Sun Dial" Gas Stoves,

IN A GREAT VARIETY OF STYLES AND SIZES.

Gas Cooking Stove No. 7C.

The Most Economical, Efficient, and Durable Gas Stove Made.

SIZE.

Stove.	*Oven.*	*Broiler.*	*Top.*
31 inches high.	9¼ inches high.	10 inches high.	21 inches high.
17 inches wide.	15 inches wide.	15 inches wide.	16 inches wide.
	12¼ inches deep.	12¼ inches deep.	
	Length over extension shelves, 32 inches.		

This Stove has three Boiling Burners in the Top or Hot Plate, and single Oven Burner.

The consumption of this Stove is 35 cubic feet per hour, at 1½ inch pressure with all burners.

Three-eighth inch supply pipe should be used when the pressure is 1½ inches or over.

ALL FITTINGS ARE NICKEL PLATED.

Catalogue showing Styles and Prices sent free on application.

DRY and WET GAS METERS

Station Meters (square, cylindrical, or in staves), Glazed Meters, King's and Sugg's Experimental Meters, Lamp Post Meters, etc., etc.

METER PROVERS (Sizes 2, 5 and 10 feet.)

Pressure Gauges of all kinds, Pressure Registers, Pressure and Vacuum Registers, Pressure Indicators (sizes 4, 6 and 9 in.), King's Pressure & Vacuum Gauges.

DRY & WET CENTER SEALS, DRY & WET GOVERNORS, EXHAUSTER GOVERNORS.

Photometers of all descriptions. Letheby's Sulphur and Ammonia Test Apparatus Complete.

Also, TESTING AND CHEMICAL APPARATUS OF ALL KINDS, AND OF THE MOST PERFECT DESCRIPTION, FOR ALL PURPOSES RELATING TO GAS.

GOODWIN'S IMPROVED LOWE'S JET PHOTOMETER.

Special attention to repairs of Meters and all Apparatus connected with the business. All work guaranteed first-class in every particular. Orders filled promptly.